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COMMONWEALTH INSTITUTE OF ENTOMOLOGY.

REVIEW
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SERIES A.

Vol. 45. 1957.

BONNEMAISON (L.) & MISSONNIER (J.). **Le psylle du poirier** (*Psylla pyri* **L.). Morphologie et biologie. Méthodes de lutte.**—*Ann. Épiphyt.* **7** no. 2 pp. 263–331, 38 figs., 83 refs. Paris, 1956.

Pear trees near Paris have for some years been severely infested by Psyllids, and investigations on their bionomics and control were carried out in the Department of Seine-et-Oise following a particularly severe attack in 1948. Of the three species present on the trees, *Psylla pyri* (L.) was more numerous than *P. pyrisuga* Först. or *P. pyricola* Först. and the only one of economic importance. Characters of the wings and of the genitalia of both sexes differentiating the three species are given, together with detailed descriptions of all stages of *P. pyri*, including the winter and summer forms of the adult [*cf. R.A.E.*, A **44** 322].

The overwintering adults of *P. pyri* were found sheltering beneath the bark or in crevices on fruit trees or under stones and dead leaves, and resumed activity towards the end of January, pairing and oviposition beginning soon after. The eggs were laid at first on the twigs and later, when the buds had opened, on the green parts. Since the nymphs feed only on the green parts, those that hatched before the buds opened died without developing. Most of the eggs were laid in March, and the first adults of the summer form were observed in late April and early May. Females of the winter form laid an average of about 400 eggs each, and those of the summer form about 600. The numbers of eggs laid daily by both forms varied with temperature but not with photo-period. In the laboratory, at 12, 15, 19 and 24°C. [53·6, 59, 66·2 and 75·2°F.], the numbers of eggs laid daily by females of the winter form averaged 2·2, 9·2, 14 and 17·2, respectively. Some unfertilised females oviposited, but none of the eggs hatched. At 10, 18 and 23°C. [50, 64·4 and 73·4°F.], the egg stage averaged 23, 10 and 7·5 days, and the five nymphal instars were completed in averages of 72, 33 and 24·5 days, respectively. In the field, the egg and nymphal stages together lasted 70 days at average temperatures of less than 9°C. [48·2°F.], 60 days at 10°C. and 35 days at 15·4°C. [59·72°F.], and there were several generations in the course of the summer [*cf. loc. cit.*].

The adults cause little damage, but feeding by the nymphs on the leaves and shoots hinders the development of the trees and particularly that of the buds, and the sooty mould that develops on the honeydew excreted by them reduces photosynthesis. In extreme cases, attack results in the loss of

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almost all the leaves and induces premature falling of the fruits. Peak numbers of *P. pyri* were usually observed between mid-June and mid-July, and again in late August and early September, when fecundity was increased by high temperatures. Though a certain degree of humidity is necessary for the development of the eggs and nymphs in the early instars, the damage caused was most severe in dry periods, when the honeydew was not washed from the trees by rain.

The Psyllids were destroyed by numerous predators of Aphids and other fruit-tree pests, notably *Orius minutus* (L.) and *Anthocoris nemorum* (L.), which attacked the eggs and nymphs in all instars [*cf.* **41** 98]. *A. nemorum* overwintered in the adult stage and had three generations a year. Parasites were rare and were usually found only in June, July and the first half of August. *Prionomitus mitratus* (Dalm.) appeared to be the most important parasite of *Psylla pyri* in July, but it was more effective against *P. pyrisuga* and also against *P. peregrina* Först., which infests hawthorn [*Crataegus*]. *Trechnites psyllae* (Ruschka) was the principal parasite in autumn. Hyperparasites were numerous at all times, however, and this is thought to account for the negligible degree of control afforded.

The use of insecticides against Psyllids is reviewed from the literature, and experiments carried out near Paris are described. Emulsion sprays containing 0·036 per cent. γ BHC or 0·014 per cent. parathion, a suspension spray containing 0·0225 per cent. parathion, and a spray of 0·00525 per cent. parathion and 0·28 per cent. oil with the addition of 0·00975 per cent. parathion in suspension, all gave complete or almost complete control of the nymphs and adults when applied to the trees on 13th October, immediately after picking and before the adults had moved to their winter quarters. Most of the parasites and predators had already completed their development and were not harmed.

In tests of spring treatments, parathion at 0·02 per cent. in a suspension spray, at 0·015 per cent. in an emulsion spray or with 0·8 per cent. oil, and γ BHC at 0·02 per cent. in an emulsion spray, applied on 2nd April, when the buds were almost completely open, greatly reduced the numbers of nymphs and adults and the parathion sprays also killed many of the eggs. In a further test in 1955, sprays were applied on 6th May, when summer adults of *P. pyri* were beginning to appear and the nymphs were almost all in the last instar. High mortality of the nymphs was given by 0·02 per cent. parathion in a suspension or emulsion spray or with 0·533 per cent. oil, and by emulsion sprays of 0·05 per cent. dieldrin or endrin, 0·04 per cent. malathion, 0·04 or 0·027 per cent. lindane [almost pure γ BHC], 0·02 per cent. Diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl thiophosphate] and 0·025 or 0·015 per cent. demeton [diethyl 2-(ethylmercapto)ethyl thiophosphate]. Toxaphene at 0·15 or 0·1 per cent. was slightly inferior and Isolan [1-isopropyl-3-methyl-5-pyrazolyl dimethylcarbamate] at 0·01 per cent. and Pyrazoxon [diethyl 3-methyl-5-pyrazolyl phosphate] at 0·02 per cent. gave poor results.

In laboratory tests against the eggs, adults of *P. pyri* were placed between 20th and 26th May on small pear plants that were sprayed on the latter date and kept at 15–25°C. [59–77°F.]. On untreated plants, 97 per cent. of the eggs had hatched 11 days later and the remainder were dead; 41·5 per cent. of the nymphs reached the fourth instar in 20 days. On the treated plants, hatching was completed in 14 days and the percentages of eggs that hatched and (in brackets) the percentages of nymphs that had reached the fourth instar by the 20th day were 2·4 (0) for 0·02 per cent. parathion, 1 (0) for 0·015 per cent. parathion with 0·4 per cent. oil, 61 (1·5) for 0·04 per cent. malathion, 93 (0) for 0·05 per cent. dieldrin, 83 (0) for 0·05 per cent. endrin, 76 (7·8) for 0·027 per cent. γ BHC, 97 (0·5) for

0·15 per cent. toxaphene and 72 (2·3) for 0·02 per cent. Diazinon, all in emulsion sprays.

Spring treatments in late April and early May are recommended, since applications then are effective not only against the nymphs of *P. pyri* but also against other pests, the foliage is not dense, and parasites and predators are not abundant.

Hurpin (B.). **Influence des conditions atmosphériques sur les sorties préalimentaires du hanneton commun** (*Melolontha melolontha* **L.**).—*Ann. Épiphyt.* **7** no. 2 pp. 333–361, 15 figs., 19 refs. Paris, 1956.

The author briefly reviews the literature on the emergence from the soil and the pre-feeding flights of *Melolontha melolontha* (L.) [*cf. R.A.E.*, A **44** 105, etc.] and gives a detailed account of observations in northern France in 1948–53 on the effect of weather on them. The first and last adults emerged on 20th April and 10th May, respectively, in 1948, 16th April and 3rd May in 1949, 30th April and 24th May in 1950, 25th April and 22nd May in 1951, 17th April and 7th May in 1952, and 20th April and 7th May in 1953. From an examination of temperature records, it is concluded that the adults become active when the soil temperature at the level at which they overwinter is at least 11°C. [51·8°F.] for two days and move towards the surface [*cf.* **44** 317]; in grassland, 86–94 per cent. of the adults overwintered at depths of 4–12 ins. There are numerous exceptions, however, due to variations in development, the nature and degree of exposure of the soil, and other factors, so that emergence is usually spread over a period. Though no strict relation between the emergence of adults and the appearance of leaves on the trees was observed, the first emergences generally coincided with the appearance of leaves on oaks and beeches and the maximum flights usually occurred when the majority of these trees, which are preferred for feeding, were in leaf.

An investigation of the factors that stimulate the evening flight of the newly emerged adults showed the essential conditions to be a temperature exceeding 12°C. [53·6°F.] at midday combined with some period of sunshine. Conditions at dusk appeared to have less influence, flights being observed at temperatures as low as 6°C. [42·8°F.].

Della Bella (D.) & Rota (P.). **Esperimenti con R 6199 nel 1955.** [Experiments with R 6199 in 1955.]—*Boll. Zool. agr. Bachic.* **21** fasc. 3 pp. 221–229, 2 graphs, 7 refs. Milan, 1955.

Further experiments with R 6199 [the hydrogen-oxalate salt of O,O-diethyl S-2-diethylaminoethyl phosphorothiolate] for the control of *Metatetranychus ulmi* (Koch) on apple [*cf. R.A.E.*, A **44** 202] were carried out in two places in northern Italy in 1955. Numerous winter eggs were observed in March in both the orchards concerned. On the untreated trees, the mites were abundant at flowering, and the population increased steadily until mid-June, reached its peak in the second half of June and early July and declined in August, very small numbers being present at the end of that month; after a slight increase in September, infestation died down completely in October. Trees sprayed with 20 parts per million R 6199 on 28th March and 14th April, or 14th and 28th April, were virtually free from mites until mid-August, when a few were present on the apical leaves. Infestation increased in September but was of little importance. When a third application was made at 30 p.p.m. to some of the trees on 18th August, complete control was obtained for the rest of the reason. A few winter eggs were observed on about 20 per cent. of the treated trees, but

these appeared to have been laid by mites migrating from untreated trees. When mites in various stages were placed on terminal leaves from trees sprayed up to 90–100 days previously, complete mortality was obtained in 36 hours.

A single application at 30 p.p.m., or at 50 p.p.m. alone or with a wetting agent, was made to other trees on 14th May, when infestation had already increased. The lower concentration gave almost complete control in 15 days and almost complete protection thereafter until mid-July; sprayed trees adjacent to unsprayed ones became lightly reinfested. The higher concentration gave complete control in 4–5 days, the wetting agent having no appreciable effect, and gave complete protection until mid-August; the population that then developed did not merit further spraying.

In further tests, R 6199 was found compatible with several common fungicides and insecticides at normal rates of application. In an orchard that was severely infested by *M. ulmi* despite treatment with another acaricide, some trees were sprayed with R 6199 at 30 p.p.m. on 28th June and 6th July and others on 28th June and 21st July. When the second application was made on 6th July, the trees remained free from infestation throughout the season, but when it was delayed until 21st July, a third application was necessary on 28th August. Trees treated once at 30 p.p.m. on 9th May remained free from infestation until about mid-August, and those treated on 9th May and 18th June were protected until the end of the season. A single application at 30 p.p.m. gave complete control of *Bryobia praetiosa* Koch on apple and *Tetranychus telarius* (L.) on vines.

No inhibition of cholinesterase was observed in blood serum from rabbits that had been fed daily for 12 days with 50 or 100 gm. per kg. body weight of the fruit treated with R 6199, beginning ten days after the application. As tests with horse serum and horse-brain cholinesterase showed that R 6199 possesses considerable anticholinesterase activity [*cf. loc. cit.*], the results obtained indicate that the residues on the fruit rapidly become harmless to mammals.

Baccolo (S.). **Esperimenti di lotta con EPN (etil-paranitrofenil-tiobenzenfosfato) contro** *Cydia pomonella* **L. e** *Paratetranychus pilosus* **Can. et Fanz.** [Experiments with EPN for the Control of *Cydia pomonella* and *Metatetranychus ulmi.*]—*Boll. Zool. agr. Bachic.* **21** fasc. 3 pp. 253–257. Milan, 1955.

In 1954, damage by *Cydia pomonella* (L.) to pears in an orchard near Lake Garda was kept within tolerable limits by nine applications of a mixture of lead arsenate and parathion, but the sprays were not effective against *Metatetranychus ulmi* (Koch) (*Paratetranychus pilosus* (C. & F.)), and large numbers of eggs of this mite were present on the trees early in 1955. In that year, several treatments were applied seven times at intervals of about 18 days or five times at intervals of about 25 days, beginning on 13th May. On 3rd September, the percentages of pears, including fallen fruits, that had been infested by *C. pomonella* were 13·2 and 14·6 for seven and five applications, respectively, of 0·12 per cent. EPN-300 (25 per cent. wettable ethyl p-nitrophenyl thionobenzenephosphonate), 7·6 for seven applications of 0·1 per cent. parathion, and 7 for seven applications of a mixture of 0·7 per cent. lead arsenate and 0·06 per cent. parathion, as compared with 65 for no treatment. No damage by the mite occurred on any of the trees sprayed with EPN, though moderate injury was observed in July on the other sprayed trees; damage on the untreated trees began in May, and the leaves had almost completely dried up and about 50 per cent. of them had dropped by 23rd July.

Menezes Mariconi (F. A.). **Alguns besouros depredadores de eucaliptos, na região de Piracicaba.** [Some Coleopterous Pests of *Eucalyptus* in the Region of Piracicaba.]—*Biológico* **22** no. 1 pp. 1–14, 5 figs., 39 refs. São Paulo, 1956.

The author gives brief descriptions of the adults of five species of Coleoptera, all of which attack the leaves of *Eucalyptus* near Piracicaba, São Paulo, together with notes on their distribution in Brazil, other food-plants, if any, economic importance and control. The insects are, in order of decreasing importance, the Eumolpids, *Sternocolaspis* (*Colaspis*) *quatuordecimcostata* (Lefèvre) [*cf. R.A.E.*, A **43** 14], *Costalimaita ferruginea* (F.), which appears to be increasing in injuriousness in Brazil and also causes considerable damage to cotton, guava and mango there, and *Colaspis quadrimaculata* (Ol.), the food-plant of which was previously unknown but which has progressively increased in numbers on *Eucalyptus* since 1953; the Rutelid, *Bolax flavolineatus* (Mannh.), which is polyphagous; and *Pantomorus xanthographus* (Germ.), small numbers of which were taken on *Eucalyptus* in December–March, this being the first record of this weevil from Brazil. The literature on all five species is summarised. Should control measures against the adults of any of them become necessary, dusts or sprays of DDT or BHC are recommended [*cf.* **43** 15].

Franco do Amaral (S.). **Porque BHC com mais de 1% no contrôle do bicho mineiro?** [Why use BHC at more than 1 per cent. for the Control of *Leucoptera coffeella*?]—*Biológico* **22** no. 3 pp. 39–47, 5 figs., 8 refs. São Paulo, 1956.

As BHC dusts for the control of *Leucoptera* (*Perileucoptera*) *coffeella* (Guér.) on coffee in São Paulo are frequently applied at excessive concentrations, tests were carried out to determine the optimum strength with regard to both effectiveness and cost. Dusts containing 0·5, 1 and 1·5 per cent. γ BHC were applied at 5 p.m. to coffee bushes beneath which cloths of uniform size had been stretched, and the adults found dead on the latter were counted on the following day at 7 a.m. and 3 p.m. The numbers at the first and (in brackets) the second count were 996 (107), 968 (87) and 719 (47) for the three concentrations, respectively, as compared with 104 (25) for dusting with talc alone, and the differences between the BHC treatments were not significant. At the time of dusting, the adults had already settled on the bushes and were not affected by any repellent effects of the BHC, but the reduction in numbers found dead at the second count appeared to indicate that adults moving freely during the day were repelled to some extent. Although a 0·5 per cent. dust is highly effective, a 1 per cent. concentration is preferred, since it also controls *Stephanoderes* (*Hypothenemus*) *hampei* (Ferr.) [*cf. R.A.E.*, A **39** 135, etc.]. It is pointed out that increasing the concentration still further would not compensate for faulty application and that if this is unavoidable, it is best to increase the rate at which the dust is applied by some 10 per cent.

Krieg (A.). **Eine Mikrosporidie aus dem kleinen Frostspanner** (*Cheimatobia brumata* **L.**). [Microsporidia from *Operophtera brumata*.]—*Naturwissenschaften* **43** pt. 8 p. 186, 2 figs., 3 refs. Berlin, 1956.

Larvae in cultures of *Operophtera* (*Cheimatobia*) *brumata* (L.) from Canada [*cf. R.A.E.*, A **44** 226] were observed to die as a result of an unknown disease. This was found to be caused by microsporidia of the genus *Thelohania*, for which the name *T. cheimatobiae*, sp. n., is proposed.

Blais (J. R.), Prentice (R. M.), Sippell (W. L.) & Wallace (D. R.). **Effects of Weather on the Forest Tent Caterpillar** *Malacosoma disstria* **Hbn., in central Canada in the Spring of 1953.**—*Canad. Ent.* **87** no. 1 pp. 1–8, 1 graph, 2 maps, 5 refs. Ottawa, 1955.

The following is almost entirely the authors' summary. Populations of *Malacosoma disstria* Hb. increased to epidemic proportions in forests of aspen, *Populus tremuloides*, over an area of about 43,000 sq. miles in central Canada in 1948–52, but were drastically reduced over most of it by unusual weather in the spring of 1953 [*cf. R.A.E.*, A **29** 395; **31** 2]. Unseasonably high temperatures in early May caused the eggs to hatch and the aspen foliage to unfold. The warm spell was followed by several days of freezing temperatures and snow and by several weeks of cool, wet weather. In northern Ontario, many of the young larvae succumbed at the time of the freezing temperatures, and many more died of starvation, since most of the aspen foliage was destroyed by the frost. Farther west, in Manitoba, fewer larvae were killed directly by the freezing temperatures, and the aspen foliage was not destroyed to the same degree. In this area, high larval mortality resulted from the prolonged cold and wet weather that followed hatching; only 5–10 per cent. of the larvae were still alive a month after hatching. The parasite, *Sarcophaga aldrichi* Parker, which had been increasing in numbers during the previous few years, was not affected by the unusual weather, and the large numbers present during the summer of 1953 further reduced the surviving larvae.

Putman (W. L.). **Bionomics of** *Stethorus punctillum* **Weise (Coleoptera: Coccinellidae) in Ontario.**—*Canad. Ent.* **87** no. 1 pp. 9–33, 1 graph, 15 refs. Ottawa, 1955.

During a study of the effects of insecticides on the arthropod fauna of peach orchards in the Niagara Peninsula of Ontario, begun in 1946, *Stethorus punctillum* Weise, a Palaearctic species, was found to have replaced the indigenous *S. punctum* (Lec.) and to have become one of the more important predators of Tetranychid mites; examination of specimens showed that all examples collected in the area in 1916–30 were *S. punctum* and all collected from 1940 onwards *S. punctillum*. This Coccinellid was found attacking *Metatetranychus ulmi* (Koch) on peach, apple, plum and cherry, *Tetranychus telarius* (L.) (*bimaculatus* Harvey) on peach, apple and various herbaceous plants, *Oligonychus* (*Paratetranychus*) *ununguis* (Jacobi) on *Castanea mollissima*, and an unidentified Tetranychid on *Thuja* and oak, but did not attack *Bryobia praetiosa* Koch on fruit trees. It also fed on predacious mites of the genus *Typhlodromus*. Observations on its bionomics were carried out, partly in the laboratory, in 1949–52, and the following is based on the author's summary of the results.

The adults hibernate near or in the soil, sometimes with little or no cover, but do not survive the winter on the trees. They emerge from hibernation in April and May and begin to oviposit in late May. There are three generations a year, the adults appearing in late June, mid-July and early August, respectively. Females of the first two generations that appear before early August oviposit during the same summer and usually also during the following one; those that emerge after early August, irrespective of generation, do not reproduce during the same season but do so during the following one or two seasons. Females that begin to oviposit may continue until late September or October, but most cease egg-laying fairly soon after midsummer and enter diapause, from which they are released only in the following spring. The greatest number of eggs laid by a female under

outdoor conditions was 845 in one season and 1,290 over two seasons. At 21·1°C. [about 70°F.], the egg, larval and pupal stages lasted 4·7, 10·25 and 5·2 days, respectively. In the laboratory, the larvae and adults attacked all stages of *M. ulmi* and *T. telarius*, but usually refused *B. praetiosa*. Seven larvae consumed an average of 239 adults of *T. telarius* each during their development; ovipositing females consumed a daily average of 40, and males an average of 20. Larvae did not survive long on other foods, but adults lived for several weeks when Aphids, raisins, or the sugary secretions of the foliar glands of peach were the only food available and were seen feeding on all of these. Eggs were laid only by females that fed on mites.

Adults of *S. punctillum* cannot oviposit nor can the larvae reach maturity unless they encounter their prey at a certain frequency. In the case of *M. ulmi*, which disperses widely over the foliage, this frequency is not attained until an incipient outbreak has developed, and the food-plant is usually seriously injured before *S. punctillum* can reduce the population. Under special conditions, such as an influx of the predator from another source, it may be of more value. *T. telarius* tends to form colonies, and is more susceptible to attack. Although *S. punctillum* alone cannot control large populations of mites, it is an important member of the biological complex that limits them. DDT and parathion were found to be highly toxic to the Coccinellid, which was almost absent from orchards sprayed with these insecticides, and the eggs and larvae were destroyed by the larvae of Chrysopids.

Chapman (J. A.) & Kinghorn (J. M.). **Window Flight Traps for Insects.** —*Canad. Ent.* **87** no. 1 pp. 46–47. Ottawa, 1955.

The trap described, which was used in 1954 for sampling flying populations of Scolytids in Canada, consists of a piece of window glass, 2 ft. square, fitted into a three-sided wooden frame from which is hung a metal trough, containing either water with the addition of a wetting agent or fuel oil, and provided with drainage for the removal of rain water. The trap is supported on a pole framework secured by guy wires and set up in the field. Insects, especially heavy-bodied ones, flying against the glass fall into the collecting fluid, and if this is oil the trap can be left unattended for many days, though wind and rain impair effectiveness by splashing the oil on to the glass. Traps were operated in both timbered areas and others where the trees had been felled; some indication was obtained that they were avoided in open situations, probably because the supports provided a visual obstruction. Nevertheless, the samples of many common insects were sufficient for observations on seasonal abundance, site distribution and the relation of flight to weather conditions.

Miller (C. A.). **A Technique for assessing Spruce Budworm larval Mortality caused by Parasites.**—*Canad. J. Zool.* **33** no. 1 pp. 5–17, 3 graphs, 21 refs. Ottawa, 1955.

This third part of a series on techniques for the study of natural populations of *Choristoneura fumiferana* (Clem.) in Canada [*cf. R.A.E.*, A **44** 159] deals with the estimation of larval mortality due to parasites, and the following is largely the author's summary of it. The mortality apparently due to parasitism (though other factors may in fact destroy some parasitised individuals) and the population trend during the larval stage of the host are the basic data for assessing mortality among larvae of *C. fumiferana* caused

by parasites. The apparent mortality due to parasites is estimated from samples of the host population, and three methods of obtaining this estimate within predetermined error limits are outlined, including two dealt with in papers already noticed [**42** 27; **44** 159]. The seasonal history of each parasite is divided into a " pre-emergence " period, when the parasite is developing within the host, and an " emergence " period, when the parasite leaves the host and the latter is actually killed. Percentage mortality among the hosts is then based on host density at the beginning of the emergence period, so that results will not be influenced by the mutual interference of other factors during the pre-emergence period. The technique and its application to life tables [**44** 159] is illustrated by means of data collected in a field plot of balsam fir (*Abies balsamea*) in 1951.

Heimpel (A. M.). **The pH in the Gut and Blood of the Larch Sawfly, *Pristiphora erichsonii* (Htg.), and other Insects with Reference to the Pathogenicity of *Bacillus cereus* Fr. and Fr.**—*Canad. J. Zool.* **33** no. 2 pp. 99–106, 1 fig., 7 refs. Ottawa, 1955.

The following is largely the author's summary. Measurements were made of the pH of the gut and blood of larvae of *Pristiphora erichsonii* (Htg.), ten other sawflies, *Malacosoma disstria* Hb. and *Bombyx mori* (L.), in their later instars, after moulting, after starvation, or as full-fed individuals. The pH of the gut was found to change regionally during development and under these different conditions, but the blood pH tended to remain relatively unchanged. The pH of the gut and blood of *P. erichsonii* approached the value (7·2–7·6) shown in a paper already noticed [*R.A.E.*, A **40** 303] to be the optimum for growth of strains of *Bacillus cereus* pathogenic for *Cydia* (*Carpocapsa*) *pomonella* (L.), and in the anterior two-thirds of the mid-gut and in the blood it was within the optimum activity range (6·6–7·4) of the enzyme lecithinase, which is produced by *B. cereus* and is in part responsible for the pathogenicity of some strains for *P. erichsonii*. This was also apparently the case for most of the other sawflies examined, but not for *M. disstria* or *Bombyx mori*, in which the pH of the mid-gut was higher. Strains pathogenic to *P. erichsonii* [*cf.* **43** 354] produced no harmful effect when fed to *M. disstria*, but caused mortality within 18 hours when injected into the blood, the mean pH of which was 6·71.

Boswell (V. R.) & others. **Effects of certain Insecticides in Soil on Crop Plants.**—*Tech. Bull. U.S. Dep. Agric.* no. 1121, [1+] 59 pp., 11 figs., 5 refs. Washington, D.C., 1955.

A detailed account is given of studies in Illinois, Georgia, Washington and New Jersey on the yield and flavour of crops grown in soil treated once with various insecticides and on the persistence of the insecticides in the soil. The treatments were made in the spring of 1950, and DDT, BHC and chlordane in wettable powders were applied directly to the soil in each of the four States. The amounts of active ingredient per acre were 9·9 and 119 lb. purified DDT, 24 and 119 lb. technical DDT, 0·5 and 15 lb. purified γ BHC, 3 and 15 lb. γ BHC from a technical product containing 6 per cent. γ BHC and 9 per cent. other isomers, and 8, 15 and 75 lb. technical chlordane. In addition, dieldrin was applied at 3, 5 and 25 lb. per acre in a water emulsion and parathion at 2, 7 and 35 lb. per acre in a wettable powder in Illinois, toxaphene was applied at 120 lb. per acre in a wettable powder in Georgia, and aldrin was applied at 3 and 60 lb. per acre in a wettable powder and DDT at 238 lb. per acre in Washington. In Illinois

and Georgia, the insecticides were suspended or dispersed in water and applied to the soil in sprays. In Washington and New Jersey, they were mixed with 20 lb. soil and clay, respectively, per acre and applied dry. The products were incorporated into the soil to a depth of 6–7 ins. The studies on the treated soils were continued for four years in Washington and New Jersey, two years in Georgia and one year in Illinois, Abruzzi rye and stringless black Valentine beans being grown as test crops on plots in all four States, and Red Mexican beans, sweet maize, beets, carrots, yellow straight-necked squash, tomatos, groundnuts, potatoes, lima beans, peas, turnips, lettuce, onions, radishes, spinach, broccoli, barley, wheat, Balbo rye and hairy vetch [*Vicia*] being grown one or more times.

The following is based on the authors' summary of the results. Crop responses to identical soil treatments with DDT, BHC and chlordane differed markedly with locality. Some of the differences may have been due in part to differences in thoroughness of mixing the insecticides with the soil at the time of application, but differences persisted between localities throughout. With few exceptions, the yields from the plots treated with DDT, BHC and chlordane at the lowest rates did not differ statistically from those from untreated plots. In Illinois, however, yields of Valentine bean pods and carrot tops were significantly lower on plots treated with γ BHC at 0·5 lb. per acre than on those that received no treatment. Yields were rarely increased above the controls, but in Illinois in 1950, 35 lb. parathion per acre increased the yield of Valentine beans and significant increases in the yield of carrots were observed in plots treated with purified DDT at 9·9 lb. per acre, technical DDT at 24 and 119 lb., technical BHC at 3 lb. γ isomer, chlordane at 75 lb. and parathion at 7 and 35 lb. The increases in the yield of carrots may have been due to control of the weevil, *Listronotus oregonensis* (Lec.), which attacked the roots shortly before harvest. No explanation was found, however, to account for exceptionally high yields of onions and squashes in New Jersey in 1951 in plots treated with γ BHC at 15 and 3 lb., respectively, or of squashes and turnips in 1952 in plots treated with chlordane at 8 lb. per acre.

The least harmful effects were observed in Illinois, where the soil was a silt loam. No significant effects were produced on radishes. Purified DDT at 119 lb. per acre gave significantly lower yields of Valentine beans than no treatment, but as technical DDT at the same rate did not, the importance of this is doubtful. There was a lower yield of carrot tops from plots treated with 3 lb. technical γ BHC per acre than on those treated with 15 lb.

In Georgia, where the plots were on a sandy loam, unusual weather destroyed all the plantings in 1950 and yield records were obtained only in 1951. The yields of maize, rye and tomatos on plots receiving up to 119 lb. DDT per acre, up to 75 lb. chlordane per acre and 120 lb. toxaphene were not significantly affected by the treatments. Purified DDT at 119 lb. per acre significantly reduced the yield of groundnuts, whereas technical DDT at the same rate did not. The effects of chlordane were not consistent. Although heavy doses of all the insecticides were harmful to tomatos, the crop failed because of bad weather and the data have little value. Technical BHC at 15 lb. γ isomer per acre significantly reduced the yields of rye and maize, and purified γ BHC at the same rate also reduced the yield of rye. Both these BHC treatments significantly increased the number of barren maize plants per plot without affecting the stand.

In Washington, where the soil was a fine sandy loam poor in organic matter and mineral colloids, the harmful and persistent effects of the insecticides were more marked than in the other States. Technical BHC at 15 lb. γ isomer per acre was highly toxic to all crops in all years, killing

Valentine beans and potatos in the first year and injuring maize so severely that no ears were harvested. Red Mexican beans were severely damaged in both the years in which they were grown. Purified γ BHC at 15 lb. per acre significantly reduced the yields of Valentine beans and maize in the first season, but not that of Red Mexican beans or potatoes in that year or of any test crop in later years. DDT at 24 lb. or more per acre was highly toxic to Valentine beans, and the effect persisted in 1953. Purified DDT appeared to be less toxic than technical DDT, but the former at 119 lb. per acre was still highly toxic to Valentine beans three years after treatment. The 24 lb. dosage did not reduce yields in the first year, possibly because it was incompletely mixed with the soil, but it did so in the subsequent three years. Red Mexican beans and carrots were highly tolerant, and yields of lima beans were reduced only by the massive dose of 238 lb. DDT per acre. Maize was highly tolerant to DDT in 1950 and 1952, the only years in which it was grown, and potatoes were not affected in the first year. In 1952, however, all potato plots that had received more than 24 lb. DDT per acre were severely damaged by mites, with resultant significant reductions in yield [*cf. R.A.E.*, A **42** 166]. Technical DDT at the two highest rates reduced the yield of peas in 1952, but the effect was not significant in 1951. DDT at rates above 24 lb. per acre significantly reduced the growth of rye in 1950–51, but the reductions were not significant in later years. The yield of turnips in 1951 was reduced by DDT at 238 lb. Chlordane at up to 75 lb. per acre had no consistent effect on the yield of any test crop in any year. Aldrin at 60 lb. per acre had no significant effect on yield except that it reduced the yield of Red Mexican beans in 1950 and Valentine beans and hairy vetch in 1952.

In New Jersey, on a rich sandy loam soil, good crops of most of the test plants were obtained in all four years, and the data were reasonably consistent, few significant differences in yield either above or below the controls occurring, even with the maximum rates of application. The only clearly harmful effects in the first year were produced by 15 lb. γ isomer in technical BHC, which markedly reduced the yields of beet, lettuce and spinach, the yield of stover but not ears of sweet maize and the yield of autumn-planted rye. Yields of Valentine beans were not affected by DDT in 1950, though there was some reduction in the same plots in subsequent years, when the chemical may have become more intimately mixed with the soil. DDT at the maximum rate reduced the growth of rye in the first year after treatment but not subsequently.

In Georgia, the flavour of the butter from groundnuts grown in plots that received the technical and purified γ BHC at the maximum rate was seriously impaired. In Washington, pronounced tainting was observed in all crops grown in 1950 on plots treated with BHC except those treated at 0·5 lb. γ isomer per acre. Extensive taste-panel tests in New Jersey showed the quality of most commodities from treated plots to be affected to some degree, and many of the ratings differed markedly from the controls, root and bulb crops from plots treated with BHC showing some of the most injurious effects. There was an apparently adverse, but less marked effect of DDT on turnips and onions. Beet quality was affected by DDT in the second year only. Heavy dosages of BHC also impaired the quality of edible seeds and fruits; beans, tomatos and especially maize were the most affected. By 1953, the effects were less marked, but still considerable, on maize and lima beans. The effects of chlordane were more erratic, less marked and less persistent than those of the other materials.

Analysis of soil from the plots in Georgia about 18 months after treatment showed that about 70–100 per cent. of the DDT, 20–80 per cent. of the BHC, 50–60 per cent. of the chlordane and 70 per cent. of the toxaphene

applied, or the respective chlorinated decomposition products, were still present. In Washington, 18 months after treatment, about 90–100 per cent. of the DDT, 15–40 per cent. of the chlordane and 50–80 per cent. of the aldrin were still present in the top foot of soil. After 2½ years, about 25–80 per cent. of the DDT remained, 20–70 per cent. of the BHC, 5–35 per cent. of the chlordane and 5–25 per cent. of the aldrin. A year later, about 40–60 per cent. of the DDT, 5–60 per cent. of the BHC, 10–20 per cent. of the chlordane and 15–40 per cent. of the aldrin were found. These values agree with other observations that DDT is highly persistent, BHC much less so, and chlordane and aldrin intermediate between them. In New Jersey, soil analyses yielded anomalous results, recoveries being lower in 1951 than in 1952 or 1953. In these latter years, about 20–55 per cent. of the DDT, 10–45 per cent. of the BHC and 15–40 per cent. of the chlordane remained, and these low recovery figures are consistent with the generally slight effects of the treatments in that area. The greater persistence of DDT and BHC in Washington as compared with New Jersey did not wholly explain the greater injury to crops in the former, and it appeared that the adverse effects associated with a given amount of insecticide are greater on sensitive test plants grown in the fine sandy loam of Washington than in the sandy loam of New Jersey.

Dickson (R. C.), Laird jr. (E. F.) & Pesho (G. R.). **The Spotted Alfalfa Aphid (Yellow Clover Aphid on Alfalfa).**—*Hilgardia* **24** no. 5 pp. 93–118, 3 figs., 22 refs. Berkeley, Cal., 1955.

The authors recognise three species of *Myzocallis* (*Therioaphis*) that infest leguminous plants in various parts of the world, *M.* (*T.*) *ononidis* (Kalt.), which develops on *Ononis* spp. in Europe and Africa, *M.* (*T.*) *trifolii* (Monell), which was described from Washington, D.C., though it was probably introduced from the old world, and has long been a minor pest of clovers in the north-eastern, middle-western and southern United States, and *M.* (*T.*) *maculata* (Buckt.), which was described from lucerne in India, attacks the same crop in Italy and Israel, and has recently become a pest of it in the south-western United States. Characters are given differentiating these three species, the last two of which have been considered synonyms of the first or confused with each other [*cf. R.A.E.*, A **3** 114; **6** 170; **43** 433, etc.]. A fourth species of the group occurs on sweet clovers (*Melilotus* spp.) in the United States; it may be *M.* (*T.*) *riehmi* (Börn.) and is easily distinguished from the other species present in that country.

M. maculata was first observed on lucerne in the United States in New Mexico in February 1954 and had been taken in California, Arizona, Oklahoma, Nevada, Colorado and Texas, as well as in Mexico, by the end of the year [*cf.* **43** 433] and in Utah and Kansas by May 1955. It is considered to have been introduced into central New Mexico, probably by air transport, in the summer or autumn of 1953, and to have spread from there; in 1954, it rapidly became the most important pest of lucerne over a large part of the dry hot areas of the south-west, but declined in numbers later in the year. The Aphid reduces the hay crop by feeding on the leaves, causing them to dry up and drop, by retarding the growth of the plants, particularly of the new shoots after the field is cut, and by killing some of the plants, particularly seedlings, and so thinning the stand. The copious honeydew excreted complicates harvesting operations.

The Aphid fed and reproduced on lucerne, bur clover (*Medicago hispida*), crimson clover (*Trifolium incarnatum*), *Melilotus officinalis*, *M. indica*, *Medicago lupulina*, *M. falcata*, *Trifolium fragiferum* and *T. hybridum* in the

greenhouse, and was observed on the first five of these and also on *T. alexandrinum* and barred medic in the field, but it did not infest red clover (*T. pratense*), *T. repens*, *T. hirtum*, *T. subterraneum*, hubam clover (*Melilotus alba annua*), vetches (*Vicia*) or *Lotus corniculatus*, and thus clearly differed in its food-plant relations from *Myzocallis trifolii* in the northern and eastern United States. Observations from June 1954 to June 1955 showed that alate and apterous parthenogenetic females were present throughout the year. A few apterous oviparae were found in mid-winter, but there was no evidence of egg-laying; no males were found. Populations and resultant damage were highest in late autumn, spring and early summer in desert regions, but injury occurred only in summer and early autumn in the cooler areas.

Insecticides, chiefly parathion, were widely used against the Aphid from the beginning of March to mid-April, when Coccinellids began to afford control and the necessity for chemical treatments diminished, though some were applied until June. Their use apparently only slightly delayed the appearance of the Coccinellids [*cf.* **44** 389], of which *Hippodamia convergens* (Guér.) and *Cycloneda sanguinea* (L.) were of importance in the Imperial Valley of California; both seemed to be present throughout the year, but the latter occurred in numbers only in spring. Other predators had little effect, and no parasites of the Aphid were found.

Chandler (S. C.). **Control of Peach Catfacing Insects in Illinois.**—*J. econ. Ent.* **48** (1955) no. 6 pp. 635–638, 9 refs. Menasha, Wis., 1956.

Investigations on the control of the insects that cause cat-facing of peaches in Illinois [*cf. R.A.E.*, A **44** 241] were continued in 1953–54. Cage tests showed that DDT, dieldrin and parathion at the rates normally used in orchard sprays killed *Lygus lineolaris* (P. de B.) and Pentatomids, whether applied directly to them or to the foliage. Dieldrin was the most effective, except for a short time after application, when parathion was superior, and these two had the longest and shortest residual effects, respectively; all were less effective against Pentatomids than against *Lygus*. In orchard tests with dieldrin, DDT and parathion at 0·25, 1 and 0·3 lb. per 100 U.S. gals. in sprays and at 2·5, 5 and 1 per cent. in dusts, respectively, applications were more effective when begun at the pink than at the bloom stage, at the early-bloom than at the late-bloom stage, and at the late-bloom than at the petal-fall stage, the differences being greater for dieldrin than for parathion. Dieldrin and DDT gave significantly better reductions in injury than parathion, but DDT was little used as it is not effective against *Conotrachelus nenuphar* (Hbst.). It is reported that C. J. Weinman found no reduction in the strength of honey-bee colonies in peach orchards sprayed with dieldrin during the flowering period.

Floyd (E. H.). **Control of the Sweetpotato Weevil and several Insects attacking Roots of Sweet Potatoes in the Field.**—*J. econ. Ent.* **48** (1955) no. 6 pp. 644–648, 1 ref. Menasha, Wis., 1956.

Cylas formicarius elegantulus (Summers) is an important pest of sweet potatoes in Louisiana, and 11 field experiments were carried out in 1941–54 to develop practical methods for the control of this and other soil-inhabiting insects that damage the tubers. Calcium arsenate was used as a dust in all of them, and weekly applications at about 10 lb. per acre for eight weeks, beginning about ten days after the plants were set in the field.

gave significant reductions in infestation by the weevil. Chlordane in a 50 per cent. wettable powder mixed with old pine sawdust and applied at 5 lb. technical compound per acre in a trench in the drill just before the slips were set was as effective in 1948 as dusting with calcium arsenate against a light infestation and resulted in practically uninjured plants when followed by eight applications of calcium arsenate. When infestation was heavy, the chlordane treatment gave less complete control, reducing a natural infestation of 35 per cent. in 1949 to 17 per cent. In 1950, applications of 2, 5 and 10 lb. chlordane per acre were equally effective against the weevil and also controlled other soil insects, including white grubs [*Lachnosterna*], wireworms, larvae of the banded cucumber beetle [*Diabrotica balteata* Lec.], mole crickets and flea-beetle larvae, and in 1951, chlordane applied in a band at 1, 2 or 5 lb. per acre in fertiliser reduced the percentage of tubers damaged by them from 36 to about 8.

In 1952, when applied in the drill before the slips were set, aldrin at 2 lb. per acre significantly reduced weevil infestation, and 1 lb. aldrin and 2–5 lb. chlordane caused equal but non-significant reductions. In another district, 2 lb. aldrin caused greater reductions in damage by *Lachnosterna* than 5 lb. chlordane per acre. In 1953, chlordane at 3 lb. and aldrin and heptachlor at 2 lb. reduced damage by *Lachnosterna* from 25 to 4·5 per cent., the insecticides being broadcast in granular form, after which the plots were disked and bedded; chlordane at 1 lb. was ineffective. In another test, chlordane and aldrin at 3 lb. per acre in granules were significantly better than no treatment or eight applications of calcium-arsenate dust against all soil insects, but aldrin and calcium arsenate were equal and more effective than chlordane or no treatment in reducing infestation by the weevil. In 1954, when the plots received no further treatment, aldrin and chlordane both gave good protection from the other insects and caused reductions in infestation by *Cylas* that were significant but of no practical value.

Aldrin and chlordane had no adverse effect on plant development, yield or flavour and were equally effective in all formulations tested. Aldrin appeared to be slightly superior against both *Cylas* and the other insects. Tubers from soil treated with 5 lb. chlordane per acre showed a maximum of 0·057 parts chlordane per million; aldrin at 2 lb. resulted in no residue. Calcium arsenate caused minor scorching of the leaves, but this did not affect the yield.

Armitage (H. M.). **Emergency Measures directed against Mexican Fruit Fly Threat to California.**—*J. econ. Ent.* **48** (1955) no. 6 pp. 657–659. Menasha, Wis., 1956.

The author discusses the importance to *Citrus* growers in California, where oranges are present throughout the year, of the recent appearance of *Anastrepha ludens* (Lw.) just south of the border with Lower California [*cf. R.A.E.*, A **44** 236] and states that a single adult, possibly a migrant, has been taken north of the border, in San Diego county. The protective measures already instituted comprise fumigation of susceptible fruits transported to Lower California from the mainland of Mexico, attempts to eradicate the fruit-fly in Lower California, and the establishment of a protective barrier five miles wide along the whole southern border of California, in which bait-sprays are applied to susceptible plants every 21 days [*cf. loc. cit.*]. Recent laboratory studies indicated that the addition of protein hydrolysate [*cf.* **44** 431] to the bait-spray of tartar emetic, sugar and water may materially increase its attractiveness to *A. ludens*. Further measures taken in the area where the one adult was found include the

addition of 4 lb. isodrin per acre to the upper two inches of soil under all likely host-fruit trees, to control pupating larvae or emerging adults, the daily examination and destruction of all prematurely coloured or fallen fruits, and the placing of traps in each tree, to catch adults before they oviposit.

Davidow (B.) & Laug (E. P.). **A Surface Aliquot masking Technique for the Bioassay of Lindane.**—*J. econ. Ent.* **48** (1955) no. 6 pp. 659–661, 1 fig., 5 refs. Menasha, Wis., 1956.

It is shown by the experiments described that the extent of contamination of surfaces in buildings by vaporised γ BHC (lindane) can be assayed from the mortality of house-flies [*Musca domestica* L.] exposed to them, provided that this mortality is within the range of 20–80 per cent., and so comparable with that obtained in standards exposed to known deposits. Batches of 75 flies are exposed on surfaces under glass dishes enclosing an area of 74 sq. cm., and their mortality from a high deposit is reduced to the necessary figure by masking part of the test area with adhesive cellophane tape. The principle of the method is that, within the limits of the assay, a given quantity of insecticide gives the same mortality percentage irrespective of the size of the area over which it is distributed. The method is reasonably accurate even when the area on which the flies are exposed to the insecticide is reduced to 1 sq. cm.

Harpaz (I.). **Bionomics of *Therioaphis maculata* (Buckton) in Israel.**—*J. econ. Ent.* **48** (1955) no. 6 pp. 668–671, 3 graphs, 3 refs. Menasha, Wis., 1956.

Of the three Aphids, *Macrosiphum pisum* (Harris), *Aphis craccivora* Koch and *Myzocallis* (*Therioaphis*) *maculata* (Buckt.), that occur in noticeable numbers on lucerne and berseem (*Trifolium alexandrinum*) in Israel, only the last ever causes severe damage; outbreaks of it occurred in the Jezreel Valley in 1936 and in the southern coastal plain in 1952 and 1953. Laboratory and field investigations on its bionomics were carried out at Rehovot in 1946–48, and details are given of the results obtained. No sexual forms were found, and parthenogenetic reproduction continued without a break. The nymphs fed on any green part of the plant but preferred the lower leaf surfaces, and reproduction began almost as soon as the adult stage was reached. There were about 40 generations a year, development was most rapid in July and the rate of reproduction was greatest in May. The hot, dry khamsin wind temporarily increased reproduction when light but caused high mortality when severe. Populations were greatest in March, June and November and lowest in September and January. Alates appeared in the field in June and the first half of July and between mid-September and the end of November, but never constituted more than half the population. The Aphid was attacked by *Coccinella septempunctata* L., *C. undecimpunctata* L., *Chrysopa carnea* Steph. and various Syrphids, especially when its numbers were high, and it was parasitised by Braconids of the genus *Praon*, which were numerous in June, November and December 1946 and in May, June and November 1947. Parasite increase lagged a fortnight behind Aphid increase, and control was therefore insufficient. There was no significant difference in the rate of development on the two plants, but some varieties of lucerne were less susceptible to injury than others. Honeydew appears on the infested plants

and leads to the development of sooty mould, but the latter does not become noticeable unless the Aphids are very numerous and was not important in the two years of the observations.

Reynolds (H. T.) & Anderson (L. D.). **Control of the Spotted Alfalfa Aphid on Alfalfa in southern California.**—*J. econ. Ent.* **48** (1955) no. 6 pp. 671–675, 7 refs. Menasha, Wis., 1956.

The authors review the spread of *Myzocallis* (*Therioaphis*) *maculata* (Buckt.) in California, the damage that it causes to lucerne, and its alternative food-plants [*cf. R.A.E.*, A **45** 11], and give an account of experiments on its control on lucerne there in July 1954 and February–April 1955. Sprays were applied at about 5–10 U.S. gals. per acre from ground equipment and at 3·5 U.S. gals. per acre by aeroplane. Excellent results were given by 2–4 oz. Systox [diethyl 2-(ethylmercapto)ethyl thiophosphate (demeton)] or parathion, 0·3 lb. endrin and, in most cases, 3 lb. toxaphene per acre, applied by either method, and by 4 oz. dimethyl 2-(ethylmercapto)ethyl thiophosphate, 8–16 oz. malathion, 11 oz. Diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl thiophosphate], 3·3 oz. Am. Cyanamid 12008 [O,O-diethyl S-isopropylmercaptomethyl dithiophosphate] and a mixture of 1 U.S. pint TEPP [tetraethyl pyrophosphate] with 1 lb. DDT per acre, applied from the ground. Moderately good control was given by ground applications of 1 U.S. pint TEPP, 1 U.S. pint 25 per cent. rotenone concentrate and 1·2 lb. DDT per acre, and poor control by 1·2 lb. Perthane [1,1-bis(p-ethylphenyl)-2,2-dichloroethane (ethyl-DDD)], 13 oz. nicotine and 4·5 oz. AC 528 (2,3-p-dioxanthio S,S-bis(O,O-diethyl phosphorodithioate). In commercial practice, the lower rates were consistently effective only on short lucerne; endrin was not satisfactory on very young seedlings.

In a few tests with dusts, 24 lb. of a mixture of 15 per cent. toxaphene with 5 per cent. DDT per acre gave excellent control and was slightly superior to 41 lb. 10 per cent. toxaphene or 20 lb. 20 per cent. toxaphene and much better than 24 lb. 1 per cent. parathion, which gave poor control. When lime-sulphur at rates ranging up to 15·3 U.S. gals. per acre was added to the water at the time of the first irrigation after cutting, there was little or no reduction in Aphid population, but the production of honeydew was inhibited. Soaking the seeds in schradan before sowing gave little protection, and similar treatments with demeton and American Cyanamid 3911 [O,O-diethyl S-ethylmercaptomethyl dithiophosphate] seriously reduced germination, but protected the surviving plants from Aphids for some time.

Hall (I. M.). **The Use of *Bacillus thuringiensis* Berliner to control the Western Grapeleaf Skeletonizer.**—*J. econ. Ent.* **48** (1955) no. 6 pp. 675–677, 8 refs. Menasha, Wis., 1956.

In laboratory tests in southern California in 1952 on the control of *Harrisina brillians* B. & McD. on vines, several viruses that cause polyhedrosis or granulosis diseases of Lepidoptera proved ineffective against the larvae [*cf. R.A.E.*, A **41** 89], but a strain of the spore-forming bacterium, *Bacillus thuringiensis*, was virulent to them when high concentrations of spores were ingested. In field tests in the summer of the same year, egg-masses produced in the insectary were attached to the leaves of wild grapes and the resultant first-instar larvae were sprayed with a suspension of 2 gm. spore powder per U.S. gal. water. Mortality was high after two days and complete after five, whereas untreated larvae suffered only 30 per cent.

mortality. In August 1954, when the suspension prepared in 1952 was applied to larvae in the second or third instars in an experimental vineyard, untreated larvae and those sprayed with 1, 5 or 10 gm. spore powder per U.S. gal. suffered 33, 46, 70 and 75 per cent. mortality, respectively, in seven days, but later treatment of a population of larvae in all instars with 8·5 or 22 U.S. gals. per acre of a suspension of 5 gm. spore powder per U.S. gal. had no apparent effect, probably because the larvae were already being controlled by a granulosis virus and by introduced insect parasites.

Brazzel (J. R.) & Martin (D. F.). **Behavior of Pink Bollworm Larvae.**—*J. econ. Ent.* **48** (1955) no. 6 pp. 677–679, 2 refs. Menasha, Wis., 1956.

Detailed laboratory and field observations on the behaviour of larvae of *Platyedra* (*Pectinophora*) *gossypiella* (Saund.) were carried out in Texas in 1954. When two larvae were confined on a single cotton seed, they avoided each other if possible, but otherwise attacked one another, and when 5–10 eggs were put on one locule of each boll, 48 per cent. of the larvae entered the boll and 35 per cent. of these were recovered, whereas when they were caged singly, 68 per cent. of the larvae entered and 95 per cent. of these were recovered. When more than one individual entered a locule, generally only one was recovered, and it is concluded that the larvae are cannibalistic [*cf. R.A.E.*, A **25** 354]. Newly hatched larvae moved over the cotton fruit, and if it was small, so that they frequently encountered one another, they migrated over the plant before entering a fruit. Relatively large numbers of these migrating larvae survived, particularly if there were many fruits on the plant.

Peterson jr. (G. D.). **Biological Control of the Orange Spiny Whitefly in Guam.**—*J. econ. Ent.* **48** (1955) no. 6 pp. 681–683, 1 ref. Menasha, Wis., 1956.

Aleurocanthus spiniferus Quaint. was first recorded in Guam in June 1951 and spread rapidly to all parts of the island but the north, which it did not reach until 1953. It soon became a serious pest of all kinds of *Citrus* and also attacked grape vines and ornamental rosaceous plants. The mild, humid climate favours the Aleyrodid, and there are 5–6 generations a year; excessively dry weather, driving rains and high winds cause high mortality at times. In April–October 1952, *Prospaltella smithi* Silv., *P. clypealis* Silv., *P. opulenta* Silv., *Eretmocerus serius* Silv. and *Amitus hesperidum* Silv., which parasitise *Aleurocanthus woglumi* Ashby on *Citrus* in Mexico, were introduced and liberated against *A. spiniferus*. Only *P. smithi* and *Amitus hesperidum* are known to have become established, but these provide 80–95 per cent. parasitism, *P. smithi* predominating, which is sufficient for commercial control.

Peterson jr. (G. D.). **Biological Control of the European Corn Borer on Guam.**—*J. econ. Ent.* **48** (1955) no. 6 pp. 683–685, 6 refs. Menasha, Wis., 1956.

Pyrausta nubilalis (Hb.) was first observed in Guam in 1911 and rapidly became an important pest of maize there. Several parasites were introduced and released against it in 1926–37, and *Lydella stabulans grisescens* R.-D. from Japan became established and gave very good control for some years [*cf. R.A.E.*, A **29** 331, etc.], but had almost disappeared by 1951, when the

borer was again extremely injurious. *Macrocentrus gifuensis* Ashm., *Angitia* (*Horogenes*) *punctoria* Roman, *L. stabulans grisescens* and *Chelonus annulipes* Wesm. were imported from the United States and liberated in 1952, and these and *Agathis agilis* (Cress.) in 1954; several adults of *L. stabulans grisescens* were recovered during the first few weeks after the first liberation, but no recoveries have been made since the second.

Taschenberg (E. F.) & Avens (A. W.). **Further Studies on Control of Potato Aphid on Tomatoes.**—*J. econ. Ent.* **48** (1955) no. 6 pp. 685–688, 4 figs., 6 refs. Menasha, Wis., 1956.

Tomato plants in western New York are severely infested by *Macrosiphum solanifolii* (Ashm.) late in some seasons, and considerable injury was caused in 1946 and 1952. Various organic phosphorus insecticides were tested for control in 1951–1952. Sprays were directed down on to the plants and also up to the lower leaf surfaces by means of a flexible pendant boom with five nozzles, and parathion, which was known from earlier tests to be effective, was used at 1 lb. 15 per cent. wettable powder per 100 U.S. gals. as a standard. Systox [diethyl 2-(ethylmercapto)ethyl thiophosphate (demeton)] at 2 oz. 50 per cent. emulsion concentrate per 100 U.S. gals. gave the best control, proving superior to the parathion standard, and 2 lb. 25 per cent. wettable malathion and 0·75–1 lb. 27 per cent. wettable EPN [ethyl p-nitrophenyl thionobenzenephosphonate] were almost as effective as the standard. Promising results were given by 1–2 lb. NPD [tetra-n-propyl dithionopyrophosphate] and by emulsion concentrates of parathion, malathion and Metacide [methyl-parathion and parathion] at 1, 2 and 2 oz. actual toxicant per 100 U.S. gals., respectively, but wettable Potasan [O,O-diethyl O-7-hydroxy-4-methyl-coumaryl thiophosphate] was inferior. The effect of the wettable-parathion spray was only slightly reduced by the addition of bordeaux mixture (8:4:100). Miscible oil in the spray mixtures appeared to reduce control by parathion and malathion, and it was apparent that single applications of any spray were inadequate for the control of severe infestations. Analyses of malathion and parathion residues on green fruits showed that these decreased by 87 and about 70 per cent., respectively, within 48 hours of application.

Ditman (L. P.), Cox (C. E.) & Kantzes (J. G.). **Treatment of Pea, Snap Bean, and Lima Bean Seed with Insecticides and Fungicides.**—*J. econ. Ent.* **48** (1955) no. 6 pp. 688–693, 2 figs., 1 ref. Menasha, Wis., 1956.

In Maryland, *Hylemyia cilicrura* (Rond.) and seed-infesting fungi sometimes cause severe losses in sowings of peas, snap beans and lima beans, and investigations on control were carried out in 1953–54 with four insecticides, lindane [almost pure γ BHC], aldrin, dieldrin and chlordane, and three fungicides, thiram [bis(dimethylthiocarbamoyl) disulphide], captan [N-trichloromethyl thiotetrahydrophthalimide] and chloranil [tetrachloro-p-benzoquinone], applied to the seeds alone and in various combinations in slurries; these were prepared by the addition of insecticide or fungicide to a solution of 2 oz. methyl cellulose per U.S. gal. water and used at the rate of 1 and 0·5 U.S. pint per bushel of seed in 1953 and 1954, respectively.

The results were extremely variable [*cf. R.A.E.*, A **39** 310], owing mainly to differences in temperature, soil moisture, variety and vitality of seed and soil fauna and flora, and indicated that cold and wet soil favours the development of decay organisms, so that the highest plant stands are obtained by the use of fungicides; that cool and moist soils result in most

reduction in plant stand due to *H. cilicrura*, so that insecticides give the best results; and that when the soil is warm and has a moisture content near the optimum, the seed germinates rapidly and is not seriously affected by either *H. cilicrura* or fungi, so that protective treatments are not necessary. Under very adverse conditions, even combined treatments with fungicides and insecticides do not result in a satisfactory plant stand.

In peas from seed treated in 1953 and sown in April of the same year, significant increases in plant stand were given by 0·25 oz. γ BHC as an emulsion concentrate per bushel of seed, alone or with chloranil, by proprietary preparations of γ BHC with thiram or captan, by 1 oz. chlordane in an emulsion concentrate and a wettable powder, both with chloranil, by 0·25 oz. aldrin or dieldrin in emulsion concentrates with chloranil, and by the fungicides alone, but not by 0·25 oz. wettable γ BHC. Although the insecticides did not entirely prevent infestation by *Hylemyia*, they reduced it, all other seedlings being infested by early May. There were no significant increases when the seed was sown in 1954, though treatment did not decrease the viability of the seed, or when fresh seed was given the same or similar treatments in 1954 and sown in the same year. Examination in the soil indicated that although decayed seed is more rapidly attacked by *H. cilicrura*, sound seed and even the stems of growing plants are sometimes severely injured by the larvae. When the insecticides were applied without fungicide, there was no direct chemical injury to the seed; stands were sometimes poor, but not significantly worse than others. Lima-bean and snap-bean seeds were treated with the same materials as the pea seed in 1953 and sown in April. All treatments except wettable γ BHC and the fungicides applied alone resulted in significant stand increases on snap beans, but only γ BHC in the concentrate, alone or mixed with thiram or captan, and these two fungicides alone did so on lima beans, though none of the treatments was commercially satisfactory. Similar results were given by the treatments tested in 1954. Sowing in August resulted in stands of over 90 per cent. for all treatments on both beans, with no significant differences between treated and untreated seed. It is concluded that treatment with both insecticide and fungicide should be given and that the insecticides are equally effective when used as emulsion concentrates.

Schopp (R.), Brindley (T. A.) & Hinman (F. G.). **Factors affecting Pinhole Injury to Dry Peas by the Pea Weevil.**—*J. econ. Ent.* **48** (1955) no. 6 pp. 693–695, 1 graph. Menasha, Wis., 1956.

Dry peas in which the larvae of *Bruchus pisorum* (L.) complete their development have large cavities in them, weigh less than sound peas, and can be removed by methods depending on gravity, but those in which the larvae die before doing much feeding show a less obvious type of damage, referred to as pinhole injury, and are difficult to remove, since the loss in weight is slight. As the adults are not easy to control on early crops, investigations were carried out in Idaho in 1940–46 to determine whether environmental factors or methods of growing the peas affected the proportion of pinhole injury. They showed that the larvae are killed by rapid hardening of the peas, resulting from either hot, dry weather or early cutting of the vines, so that it is advisable to plant early, with the expectation that in most years the crop will mature before the weather becomes hot and dry, and to delay harvest until the peas are ripe. These measures are in accord with good cultural practice. Larger yields are usually obtained from early crops, and early cutting is believed to be a cause of poor germination in seed peas and of poor quality in dry edible peas, because of shrivelling.

Glass (E. H.) & Chapman (P. J.). **Summer Control of the Apple Aphid.** —*J. econ. Ent.* **48** (1955) no. 6 pp. 695–697, 2 refs. Menasha, Wis., 1956.

In experiments against *Aphis pomi* Deg. on apple in New York in 1952, sprays of TEPP [tetraethyl pyrophosphate], parathion, methyl-parathion, Chlorthion [O,O-dimethyl O-3-chloro-4-nitrophenyl thiophosphate] and NPD [tetra-n-propyl dithionopyrophosphate], and of nicotine sulphate with lime, applied on 7th July, gave poor control in the first 48 hours and none after two weeks, 0·5 lb. malathion or 0·25 lb. lindane [almost pure γ BHC] per 100 U.S. gals., applied on 7th or 22nd July, gave high immediate control but had little residual effect, and 42 per cent. demeton [diethyl 2-(ethylmercapto)ethyl thiophosphate] and 25 per cent. Isolan [1-isopropyl-3-methyl-5-pyrazolyl dimethylcarbamate] applied at 4 and 8 fl. oz. per 100 U.S. gals., respectively, on 7th July or at 8–16 and 16 fl. oz. on 22nd July gave good immediate control and kept populations low for about two weeks, after which the Aphid multiplied readily on new growth.

In 1953, applications were made on 13th or 28th July. TEPP, parathion and nicotine sulphate, applied on the first date, gave better immediate results but still had little residual effect, and Chlorthion, lindane [γ BHC], 4389 (O,O-dimethyl S-(1,2-dicarbethoxyethyl) thiophosphate), and endrin, on one date or the other, were about as effective; 21 per cent. demeton, 25 per cent. Isolan and 50 per cent. dimethyl 2-(ethylmercapto)ethyl thiophosphate [methyl-demeton] at 16 fl. oz. per 100 U.S. gals., applied on the first date, gave excellent control for three weeks or more. In 1954, applications were made on 6th July. TEPP and parathion gave poor results, and malathion, Chlorthion, Diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl thiophosphate], OS 2046 (dimethyl 2-carbomethoxy-1-methyl-vinyl phosphate) and γ BHC showed good initial kill but little residual control. Systemic insecticides were again the most effective, 4–8 fl. oz. 21·2 per cent. demeton or 47 per cent. methyl-demeton and 16 fl. oz. 25 per cent. G-22870 (3-methyl-5-pyrazolyl dimethylcarbamate) per 100 U.S. gals. showing more residual control after two weeks than 4–8 fl. oz. 50 per cent. Am. Cyanamid 12008 or 12009 [O,O-diethyl S-isopropyl- and O,O-diethyl S-propylmercaptomethyl dithiophosphate, respectively], 1·25 fl. oz. OS 2046 or 5 fl. oz. 25 per cent. OS 1808 (diethyl 2-carbethoxy-1-methyl-vinyl phosphate).

The superiority of the systemic insecticides is probably due largely to the habit of the Aphid of infesting the growing tips and so avoiding contact with the residues from sprays applied only once, however thorough the application may be. The most persistent in their effect were demeton, methyl-demeton, Isolan and G-22870.

Gyrisco (G. G.), Evans (W. G.), Burrage (R. H.) & Briant (A. M.). **Further Studies on the Effects of Soil Treatments with Insecticides on Residues and Fruit Quality of Strawberries.**—*J. econ. Ent.* **48** (1955) no. 6 pp. 700–703, 5 refs. Menasha, Wis., 1956.

The following is based on the authors' summary. In 1952, a gravelly loam soil in Wayne County, New York, was treated with 1, 2 or 4 lb. aldrin, dieldrin, lindane [almost pure γ BHC] or heptachlor per acre just before strawberry plants were set out in it, and in 1953 and 1954 fresh-frozen fruits and jam made from fruits from the treated plots were tested for flavour and odour. There were no effects on the fruits [*cf. R.A.E.*, A **43** 317], and the jam was affected only by aldrin, which altered the flavour at all concentrations, though not objectionably. Chemical analysis of the

frozen fruit and bioassay with *Drosophila melanogaster* Mg. revealed no residues exceeding those shown by the untreated controls.

Foster (J. R.). **The Effect of Ingredients in Insecticides on the Behavior of the Japanese Beetle.**—*J. econ. Ent.* **48** (1955) no. 6 pp. 703–706, 1 ref. Menasha, Wis., 1956.

The following is substantially the author's summary. Adults of *Popillia japonica* Newm. are of importance in Maryland because they prevent the fertilisation and subsequent development of maize kernels by feeding on the silks at the time of pollination. Maize for canning is usually protected during this period by spraying it with DDT, but the large numbers of beetles observed in the fields on the day after treatment suggested that the insecticide or some other spray ingredient was attractive to them. Various solvents, emulsifiers, oils and insecticides were therefore tested in commercial formulations in the summers of 1950 and 1951 for attractant or repellent qualities, in combination with a standard attractant and with DDT in traps of the standard type. The response of the beetle was so erratic that conclusions were difficult to draw. In general, the commercial formulations of solvents, emulsifiers and insecticides were repellent, and there was no evidence that any were strongly attractive, although a few, including toxaphene and a formulation of pyrethrins, piperonyl butoxide and petroleum distillate, were possibly slightly attractive. The addition of the standard attractant masked the effect of all but the most repellent ingredients, whereas the addition of DDT had little effect. The results do not support the hypothesis that *P. japonica* is attracted to maize fields by the presence of DDT, and they were confirmed by field tests in which maize was sprayed at various stages of growth.

Morrison (H. E.) & Thompson (B. G.). **Control of Hop Aphid and Two-spotted Spider Mite in Oregon.**—*J. econ. Ent.* **48** (1955) no. 6 pp. 706–710, 16 refs. Menasha, Wis., 1956.

The authors describe the bionomics of *Phorodon humuli* (Schr.) and *Tetranychus telarius* (L.), the principal pests of hops in Oregon, and review control measures that have been used against them. By 1952, dusts of 1 per cent. TEPP [tetraethyl pyrophosphate] or parathion were known to be effective against both pests when applied at 40 lb. per acre, but as they were also very toxic to natural enemies, a high degree of initial control was necessary to prevent rapid reinfestation. Aphid control should be provided by the first week of July, and mite development usually occurs in late July or early August, so that one application of either compound would probably fail to give adequate control of both species, and as TEPP does not affect the eggs of the mite, four or more applications per season might sometimes be required.

In 1952, 0·2 and 0·4 lb. demeton [diethyl 2-(ethylmercapto)ethyl thiophosphate] in 100 U.S. gals. spray per acre gave excellent control of the mite. In 1953, greenhouse tests showed that demeton was translocated through the plants from the roots but not from the foliage and indicated that 1 oz. actual compound per acre should be effective against both pests. In field tests of various sprays applied in July, 1–8 oz. demeton per acre gave good control of both species, and 8 oz. maintained this for 33 days and was more effective than 24 oz. schradan or 8 oz. parathion or Diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl thiophosphate] against both species in 1953 and than 32 oz. malathion or 8 oz. dimethyl 2-(ethylmercapto)

ethyl thiophosphate [methyl-demeton] against the Aphid in 1954, when mite infestation did not develop. Dried hops from plants sprayed with 8 oz. demeton per acre five days before picking showed no residue. The application of demeton to the hops by means of an overhead irrigation system proved successful in 1954.

Blanchard (R. A.), Wene (G. P.), Douglas (W. A.) & Gouck (H. K.). **Insecticides in Mineral Oil Emulsions for Control of the Corn Earworm and Fall Armyworm in Sweet Corn.**—*J. econ. Ent.* **48** (1955) no. 6 pp. 714–718, 16 refs. Menasha, Wis., 1956.

Experiments on the control of severe infestations of *Heliothis zea* (Boddie) (*armigera*, auct.) on sweet maize by means of emulsion sprays to which mineral oil was added were carried out in Texas in 1949–52 and in Illinois, Alabama and Indiana in one or more of these years. The oil was added at 10 per cent. in 1949 and at 7·5 per cent. in 1950–52, and two applications were made in 1949 and 1950, 2–3 in 1951 and three in 1952. DDT, used at 0·25–1 per cent., and endrin at 0·03–0·2 per cent., gave the best results, based on a comparative-ranking appraisal, toxaphene at 0·75–1·5 per cent. and DDD (TDE) and heptachlor at 0·5–1 per cent., were almost as effective, and Prolan [1,1-bis(p-chlorophenyl)-2-nitropropane] and Bulan [1,1-bis(p-chlorophenyl)-2-nitrobutane] at 0·5–0·75 per cent., Dilan [a 1:2 mixture of Prolan and Bulan] at 0·5–1 per cent., dieldrin at 0·75 per cent. and methoxy-DDT (methoxychlor) at 0·5–1·5 per cent. showed promise. Aldrin, fluoro-DDT, pyrethrum, lindane [γ BHC], allethrin and isodrin were unsatisfactory, and although ethylene dichloride was very toxic, its high volatility made it unsatisfactory for application in an oil emulsion. The addition of 0·2 per cent. TEPP [tetraethyl pyrophosphate] did not increase the effectiveness of 0·25 per cent. DDT. Toxaphene caused moderate or severe scorching of the maize when used at strengths necessary to give good control, but none of the other insecticides injured the plants.

Laphygma frugiperda (J. E. Smith) was abundant in Illinois in 1950, and five of the insecticides were tested against it. DDT, DDD and γ BHC gave complete control in one experiment and very satisfactory control in another, and fluoro-DDT and allethrin reduced populations by 85 and 62 per cent., respectively.

Medler (J. T.). **Control of common Alfalfa Insects in Wisconsin.**—*J. econ. Ent.* **48** (1955) no. 6 pp. 718–723, 6 refs. Menasha, Wis., 1956.

Two crops of lucerne are normally grown each year in Wisconsin. The first develops under favourable conditions, before insects become abundant enough to reduce the yield seriously, except in the east-central area adjacent to Lake Michigan, where *Philaenus leucophthalmus* (L.) causes up to 20 per cent. loss, but is controlled by chlorinated-hydrocarbon sprays [*cf. R.A.E.*, A **43** 316], whereas the second is often grown under unfavourable conditions, including continuous migration of insect pests into the young growth. The most injurious of these are the Mirids, *Lygus lineolaris* (P. de B.) and *Adelphocoris lineolatus* (Goeze), the Cicadellid, *Empoasca fabae* (Harris), and grasshoppers, predominantly *Melanoplus mexicanus mexicanus* (Sauss.) and *M. femur-rubrum* (Deg.). The factors to be considered in using insecticides for their control on seed and fodder crops are discussed, and details are given of experiments in 1950–52 and 1954 with organic insecticides applied in 10 U.S. gals. emulsion spray per acre. For control on a fodder crop, on which persistent residues are undesirable, parathion at 0·33 lb. per acre

appeared to be fairly effective, but it cannot be generally recommended because of its acute toxicity. No other single toxicant was effective against all the insects, but 1–2 lb. methoxy-DDT (methoxychlor) or 0·5–1 lb. Perthane [1,1-bis(p-ethylphenyl)-2,2-dichloroethane (ethyl-DDD)] controlled the Cicadellid, and 0·25 lb. aldrin or heptachlor was effective against the Mirids and grasshoppers; a mixture of the two types of insecticide appeared the most satisfactory. No single material gave the high persistent control necessary for seed production, the best being a mixture of 0·5 lb. DDT and 0·125 lb. dieldrin per acre or similar mixtures of one insecticide effective against the Cicadellid and one against the other insects.

Smith (E. H.). **Further Studies on the ovicidal Action of Parathion to Eggs of the Peach Tree Borer.**—*J. econ. Ent.* **48** (1955) no. 6 pp. 727–731, 4 figs., 13 refs. Menasha, Wis., 1956.

Parathion has been shown to prevent the eggs of *Aegeria* (*Sanninoidea*) *exitiosa* Say from hatching [*cf. R.A.E.*, A **43** 324–325], and tests were therefore carried out on its effect on the respiratory rate of developing eggs and the stage most susceptible to it. The respiratory rate of normal eggs was found to increase about fivefold during the 8·5 days of incubation necessary for hatching at 80°F. When eggs 1–7 days old were immersed for two minutes in a toxic suspension of parathion, the rate continued to increase normally until about a day before hatching was due and then declined progressively for several days beyond the normal hatching time. Increased concentrations tested on eggs two days old gave similar results, though the decline and cessation of respiration occurred a little earlier. When the mortality rate was considered, older eggs were the most susceptible, a break in susceptibility occurring at the age of 4–5 days, with little difference before and after it, and suspensions were more toxic than emulsions. Opposite results were obtained when eggs were kept between filter papers that had been dipped in 0·035 per cent. parathion, the youngest ones being the most susceptible, and this is believed to be the more reliable finding.

Although the mechanism of ovicidal action was not established, it is suggested that young eggs are the most permeable by parathion vapour, and that the toxicant taken up by the egg is retained as such or metabolised to a more active anti-cholinesterase substance. Its inhibitory action does not prove lethal until embryonic development nears completion, and the extended sub-normal respiratory rate is probably a secondary effect of poisoning.

Snapp (O. I.). **Peach Insect Investigations at Fort Valley, Georgia, during 1954.**—*J. econ. Ent.* **48** (1955) no. 6 pp. 734–736, 4 refs. Menasha, Wis., 1956.

Investigations on the control of insect pests of peach in Georgia were continued in 1954 [*cf. R.A.E.*, A **43** 322, etc.]. When larvae of *Conotrachelus nenuphar* (Hbst.) were allowed in that year to enter soil that had been treated with 2 or 4 lb. aldrin or 2 or 4 lb. dieldrin per acre in 1952 or with 4 lb. heptachlor or isodrin in 1953, 0–1·6, 1–1·6, 2·1–2·5, 1·1–1·5, 0 and 5·8 per cent., respectively, transformed to adults and emerged, as compared with 27·3–57 per cent. in untreated soil [*cf.* **43** 323]. In a laboratory test, 4 lb. aldrin per acre in the soil was very effective against the immature stages, and much more so when applied as a 2 per cent. granulated formulation than at 2 lb. per U.S. gal. in an emulsion concentrate, and in the field, an aldrin dust reduced the numbers of adults in the

trees and the fruit infestation at harvest when applied to the soil below peach trees at 4 lb. per acre.

In tests of sprays applied at petal-fall, shuck-fall, two weeks after shuck-fall and four and two weeks before harvest, or on some of these dates, 2 lb. 15 per cent. parathion or 25 per cent. malathion or 1·5 lb. 25 per cent. EPN [ethyl paranitrophenyl thionobenzenephosphonate] per 100 U.S. gals. on all five dates, the parathion spray on the last four dates, 0·5 lb. 50 per cent. dieldrin on the first three and 2 lb. 15 per cent. parathion on the last two dates, and schedules of 0·5–1 lb. 50 per cent. wettable dieldrin, 2 lb. 25 per cent. aldrin, heptachlor or CS-728 [1-phenyl-1-p-chlorophenyl-2-nitrobutane] on all but the last date gave good control, whereas four applications of 1 U.S. quart 18·5 per cent. endrin emulsion concentrate did not. Five applications at 1–1·3 U.S. gals. per tree of sprays of 2 lb. 15 per cent. parathion per 100 U.S. gals. were more effective than five at half the rate and double the concentration. Analysis of ripe peaches indicated that the use of chlorinated insecticides, such as aldrin, dieldrin and heptachlor, should be limited to the early part of the spray season to avoid the danger of excessive residues; malathion appeared to leave no residue at harvest. In preliminary cage tests, fresh deposits of 2–3 lb. 50 per cent. Strobane [a chlorinated mixture of α-pinene isomers with a chlorine content of approximately 66 per cent.], 1–4 lb. 25 per cent. Chlorthion [O,O-dimethyl O-3-chloro-4-nitrophenyl thiophosphate], 2 lb. 50 per cent. Perthane [1,1-bis(p-ethylphenyl)-2,2-dichloroethane (ethyl-DDD)] or 15 per cent. parathion or 1 lb. 36 per cent. methyl-parathion per 100 U.S. gals. all showed promise against adults.

Counts of larvae of *Aegeria* (*Sanninoidea*) *exitiosa* Say in late April or early May 1954 on trees 2–6 years old of which the trunks had received four monthly applications of wettable-powder sprays in July–October 1953 showed that 4·8 lb. 10 per cent. γ BHC, 5·3 lb. 75 per cent. DDT and 2 lb. 15 per cent. parathion per 100 U.S. gals. resulted in 0–1, 0–1 and 0–2·2 living examples per tree, respectively, whereas emulsions of ethylene dichloride or trichlorobenzene, applied to the soil round the trunks in late October, resulted in 0–0·1 and 0–0·4 [*cf.* **43** 324]. Although BHC and DDT were better than parathion, they do not give adequate protection in heavily infested orchards where there is a long oviposition period, though they might prevent infestation from developing if applied every year from the time the trees are set out. The emulsions give excellent control in both bearing and non-bearing orchards, irrespective of the degree of infestation, but trichlorobenzene injured two-year-old trees. When nursery stock treated with the trunk sprays on the same dates was examined in January 1954, DDT proved somewhat more and parathion somewhat less effective than BHC, the infestation percentages averaging 4·2, 13·3 and 7·6 per cent., respectively, as compared with 37·8 for no treatment.

In tests against *A.* (*Synanthedon*) *pictipes* G. & R. [*cf.* **43** 324], spraying areas on infested peach trees with 3 lb. 25 per cent. malathion, 2 lb. 25 per cent. EPN or 3 lb. 15 per cent. parathion per 100 U.S. gals. on 2nd April, 1st May, 14th August and 8th September 1953 reduced the number of living larvae per area in February 1954 from 1·52 for no treatment to 0·31, 0·13 and 0·09, respectively.

Merkl (M. E.) & Pfrimmer (T. R.). **Light-trap Investigations at Stoneville, Miss., and Tallulah, La., during 1954.**—*J. econ. Ent.* **48** (1955) no. 6 pp. 740–741, 6 refs. Menasha, Wis., 1956.

Light-traps were installed in March 1953 at Stoneville (Mississippi) and Tallulah (Louisiana) to detect a possible spread of *Platyedra* (*Pectinophora*)

gossypiella (Saund.), to cotton in the Mississippi Delta. Mercury-vapour 100-watt spot lamps were used in Mississippi and these and 15-watt ultraviolet fluorescent lamps in Louisiana, and lists are given showing the Lepidoptera caught in the two localities from 1st January to 30th September and from 1st June to 1st October 1954, respectively; they did not include *P. gossypiella*. Comparison of the results showed that *Heliothis zea* (Boddie) (*armigera*, auct.) and *H. virescens* (F.) responded similarly to the two forms of light, being slightly more attracted to the ultraviolet [*cf. R.A.E.*, A **44** 120], and since there was a highly significant relation between the numbers of adults of *H. zea* caught and the numbers of eggs per 100 terminals in cotton fields during the summer, it is possible that damaging outbreaks of these and possibly other moths could be predicted several days or weeks in advance by the use of light-traps. Over 92 per cent. of the *Heliothis* adults caught at Stoneville in April–September were *H. zea*, whereas less than 70 per cent. of the larvae collected in cotton fields were of that species, and at Tallullah it represented 96 per cent. of the moths caught and 83 per cent. of the larvae collected. The difference is due to the fact that *H. zea* is attracted from crops other than cotton, whereas *H. virescens* is largely restricted to cotton in the Delta area; the relative proportions of the two species caught in the traps may therefore closely reflect the relative numbers in a given area. *Agrotis ypsilon* (Hfn.) and *A. malefida* Gn. were both more attracted to the ultraviolet than to the mercury-vapour lamps, but *Protoparce sexta* (Joh.) and *P. quinquemaculata* (Haw.) did not behave similarly, 59 and 29 per cent., respectively, of the totals being attracted to the ultraviolet lights.

Wolfenbarger (D. O.) & Van Middelem (C. H.). **Reductions of insecticidal Residue on mature Green-wrap Tomatoes.**—*J. econ. Ent.* **48** (1955) no. 6 pp. 744–746, 5 graphs, 10 refs. Menasha, Wis., 1956.

Residue analyses were made in Florida on tomato fruits from plants that had received nine spray applications, the last eight at weekly intervals, in 1953 or eight at intervals of a week in 1954 for the control of Agromyzids of the group of *Liriomyza pusilla* (Mg.) in the leaves and fruit injury by *Heliothis zea* (Boddie) (*armigera*, auct.) and *Laphygma frugiperda* (J. E. Smith). The insecticides were combined with fungicides, and the total quantities per acre applied during the season were 12·6 lb. DDT, 20·9 lb. Dilan [a 1:2 mixture of 1,1-bis(p-chlorophenyl)-2-nitropropane and 1,1-bis(p-chlorophenyl)-2-nitrobutane], 1·6–4·2 lb. EPN [ethyl p-nitrophenyl thionobenzenephosphonate], 16·7 lb. malathion and 1·5–2 lb. parathion, all in wettable powders, 3·3 lb. demeton [diethyl 2-(ethylmercapto)ethyl thiophosphate] and 0·7–2·9 lb. parathion in liquid concentrates, and 1·5 lb. wettable parathion with 7·3 lb. wettable DDT in combined sprays or 2·3 lb. parathion in liquid concentrate and 7·3 lb. wettable DDD (TDE) in alternate applications. All residues were less than 2 parts per million 3–4 hours after the last application, and successively smaller amounts were found 2, 3, 6, 7 and 14 days later. Straight-line relationships were observed when the logarithms of the periods after treatment (in days) were plotted against the residues (in p.p.m.) on semi-logarithmic graph paper.

Wolfe (H. R.). **Acaricides in Insect Vector Virus Research.**—*J. econ. Ent.* **48** (1955) no. 6 pp. 749–750, 1 ref. Menasha, Wis., 1956.

Investigations on the insect vectors of fruit-tree viruses have been carried out for several years at Wenatchee, Washington, where many stone-fruit

trees and annual plants are used to rear or test the insects concerned. The work was often hampered by infestation of the plants by spider mites, especially *Tetranychus telarius* (L.), which increased rapidly on celery and peach seedlings in rearing cages and often killed the plants prematurely. Experiments were therefore carried out to find materials that would control the mites without injuring Cicadellids or Aphids. Spraying with 1·5 lb. 25 per cent. Chlorobenzilate [ethyl 4,4′-dichlorobenzilate] or Methyl Chlorobenzilate (methyl 4,4′-dichlorobenzilate) per 100 U.S. gals. gave good control of *T. telarius* in the greenhouse and prevented increases in occasional light infestations of *Metatetranychus ulmi* (Koch). Individual plants were thoroughly sprayed just before use for rearing or testing and whenever mite infestations developed on them; applications were usually necessary at intervals of three weeks to control the general mite population. Sprays of 2·5 lb. 20 per cent. Mitox (p-chlorobenzyl p-chlorophenyl sulphide) per 100 U.S. gals. were effective against immature but not adult mites [*cf. R.A.E.*, A **42** 67], and this material was therefore used only in combination with Chlorobenzilate to prevent the increase of active stages. These sprays caused no apparent injury to Cicadellids of 13 species or to *Myzus persicae* (Sulz.), *M. cerasi* (F.) and *Macrosiphum solanifolii* (Ashm.) under greenhouse conditions and had no phytotoxic effect on most of the plants to which they were applied. Sprays of up to 2 lb. Chlorobenzilate or Methyl Chlorobenzilate or 4 lb. Mitox per 100 U.S. gals. had no apparent effect on the eggs, nymphs or adults of *Colladonus geminatus* (Van D.), the Cicadellid mainly used for experimental purposes, or on celery, which is the plant most commonly used for rearing Cicadellids at Wenatchee.

Heinze (K.). **Survival of Aphids after Injection.**—*J. econ. Ent.* **48** (1955) no. 6 p. 751, 2 figs., 4 refs. Menasha, Wis., 1956.

During studies on the fate of Aphid-borne plant viruses in their Aphid vectors, techniques were tested for injecting virus-containing fluids into adult apterae. The main difficulties were the small size of most Aphids and the high outward pressure of the body fluids, but a micropipette slightly thinner at the tip than the tibia of an Aphid was successfully used, and the wounds inflicted soon healed in most cases, with no permanent effects on survival or reproduction. The preparation and use of the pipette are described. In tests with the pea-enation virus and its vector, *Macrosiphum* (*Acyrthosiphon*) *pisum* (Harris) (*destructor* (Johns.)), both the sap of infected plants and the blood of infective Aphids were injected, and punctures with insect pins dipped in virus-containing liquids were also tested. Survival was much lower after injection of plant sap than of insect blood, and numerous attempts over a period of ten months resulted in no mechanical transmission of the virus to the Aphid. Similar attempts with the leaf-roll virus of potato and *Myzus persicae* (Sulz.) were successful.

Lindgren (D. L.) & Gammon (C.). **Effect of Acrylonitrile Fumigation on Diapause in the Walnut Husk Fly.**—*J. econ. Ent.* **48** (1955) no. 6 pp. 752–753, 2 refs. Menasha, Wis., 1956.

Pupae of *Rhagoletis suavis completa* Cress. have been shown to remain in diapause for up to two years or more [*cf. R.A.E.*, A **20** 28; **23** 417]. During investigations in 1953 on the fumigation of the pupae, with a view to sterilising burlap sacks and preventing the spread of the Trypetid to walnuts in northern California, it was observed that exposure to acrylonitrile at atmospheric pressure had some effect on the termination of the diapause,

12 and 41 per cent. of examples fumigated at 2 lb. per 1,000 cu. ft. for four hours at 70°F. in November 1953 transforming to adults by December 1953 and March 1954, respectively, when none and only 6 per cent. of untreated pupae had transformed. Between 1st October 1954 and 18th March 1955, successive batches of 100 pupae were fumigated at intervals of three weeks at a temperature of 70°F., and adult emergence was recorded twice a week. Counts of adults and dissection of the remaining puparia in late August 1955 showed that 81 per cent. of the untreated insects, 74–79 per cent. of those fumigated with 1–3 lb. acrylonitrile per 1,000 cu. ft. for two hours or 2–2·5 lb. for two hours and 56 per cent. of those treated with 3 lb. for three hours had survived, indicating that fumigation caused little mortality except with a high dosage and long exposure. The proportions of pupae that transformed to adults were higher for pupae treated with 2·5 lb. acrylonitrile per 1,000 cu. ft. for three hours 10–130 days after formation or with 3 lb. for three hours after 136–173 days than for untreated pupae on all examination dates up to 280 days after treatment, whereas they were lower after 30–45 days for those receiving the heavier dosage 178–193 days after pupation than for untreated ones and higher after 60–120 days. As some pupae in the last age group were about to become adult, it is possible that fumigation had a temporary depressing effect, in contrast to its effect in accelerating the termination of diapause in younger pupae. Similar results were obtained with fumigation at 2 lb. for three hours, 3 lb. for two hours and 1 lb. for two hours, though they were less marked in the last case.

Simeone (J. B.) & MacAndrews (A. H.). **The Old House Borer in New York State.**—*J. econ. Ent.* **48** (1955) no. 6 pp. 753–754, 1 map, 1 ref. Menasha, Wis., 1956.

Although encountered less frequently than other insects that damage building timbers, *Hylotrupes bajulus* (L.) is a serious pest of wooden structures in the north-east of the United States, and the authors give a list of the localities in the State of New York in which it has been found since 1900 and show their distribution on a map.

Krantz (G. W.). **Some Mites injurious to Farm-stored Grain.**—*J. econ. Ent.* **48** (1955) no. 6 pp. 754–755, 4 refs. Menasha, Wis., 1956.

The following is based on the author's summary. Although only a few species of mites feed on the whole kernels in stored grain, infestation by any species may result in indirect injury, and contamination, raising of the moisture content and temperature of the grain and dissemination of plant-disease pathogens may prove more serious than the injury caused by actual feeding. A study of 56 samples of stored wheat from 15 counties in the west of New York State showed that mites were responsible for most of the injurious infestations. Those found to feed on the wheat kernels were *Tyroglyphus farinae* (Deg.), *Tyrophagus castellanii* (Hirst), *Tyrolichus casei* (Oudm.), *Alcuroglyphus ovatus* (Troup.), *Chortoglyphus arcuatus* (Troup.) and *Glycyphagus destructor* (Schrank).

Kaloostian (G. H.). **A magnetically suspended Insect Cage.**—*J. econ. Ent.* **48** (1955) no. 6 pp. 756–757, 2 figs. Menasha, Wis., 1956.

The need for a small cage that could be easily attached to a leaf, for confining Aphids used in investigations on virus vectors, led to the development of one held in place by means of a small magnet on the opposite side

of the leaf. It has a floor of 150-mesh nylon cloth, through which the Aphids feed, and transfers are effected by moving the cage with the Aphids in it. Its construction is described and illustrated.

Ruppel (R. F.). **Effectiveness of certain residual Insecticides in preventing Emergence of the Bean Weevil from infested Bean Seeds.**—*J. econ. Ent.* **48** (1955) no. 6 pp. 757–758, 8 refs. Menasha, Wis., 1956.

Bean seed stored in Colombia is severely attacked by *Bruchus* (*Acanthoscelides*) *obtectus* Say and, at Palmira, by *Spermophagus* (*Zabrotes*) *subfasciatus* Boh. It is protected by drying to 15–17 per cent. moisture content, treating with DDT at 1:1,000 by weight in a slurry or 5 per cent. dust, and storing in multi-walled paper bags. This gives adequate protection against attack, but does not kill all the Bruchids in the seeds, and experiments were made to find an insecticide that would give the necessary protection and also kill the insects within the beans. Examination on 17th August 1953 of samples infested by *B. obtectus* that had received various treatments on 14th July showed that heptachlor, chlordane and isodrin at 1:1,000 by weight of beans in 5 per cent. dusts, and BHC, aldrin and dieldrin at 1:2,000 in 2·5 per cent. dusts, caused great reductions in the numbers of emergence holes and significantly reduced the numbers of active adults and loss of seed weight, whereas endrin at 1:2,000 in an 18·5 per cent. emulsion concentrate reduced emergence, but not loss in weight, and Pyrenone Grain Protectant (a dust containing 0·85 per cent. piperonyl butoxide and 0·05 per cent. pyrethrins) at 1:500, methoxy-DDT (methoxychlor), Perthane [1,1-bis(p-ethylphenyl)-2,2-dichloroethane (ethyl-DDD)] and toxaphene at 1:1,000 in 5 per cent. dusts and DDT at 1:1,000 were less effective in all respects. DDT gave better results in 5 per cent. dust than in slurry, indicating that factors other than fumigant effects cause part of the kill within the seeds. Of the effective insecticides, isodrin is very toxic, BHC retarded germination and hindered the formation of the secondary roots of seedlings, and chlordane and dieldrin reduced germination. Heptachlor and aldrin thus appear to be the most suitable for use.

Peterson jr. (G. D.). **Biological Control of *Epilachna philippinensis* Dieke in Guam.**—*J. econ. Ent.* **48** (1955) no. 6 pp. 758–759. Menasha, Wis., 1956.

Epilachna philippinensis Dieke, which is a serious pest in the Philippines, was first recorded in Guam in November 1948. It became the most serious pest of egg-plant [*Solanum melongena*] and tomato there and also attacked peppers [*Capsicum*] and wild solanaceous plants, but rarely tobacco. It occasionally injured species of *Bauhinia* and the leaves of zinnia and caused severe damage to experimental plantings of potato and garden huckleberry.

Attempts in 1950 and 1952 to control the Coccinellid by the introduction and release of *Paradexodes epilachnae* Aldrich, a Tachinid that parasitises *E. varivestis* Muls. in Mexico, were unsuccessful, but better results were given by the Eulophid, *Pediobius* (*Pleurotropis*) *epilachnae* (Rohw.), which was introduced in pupae of *E. philippinensis* from the Philippines in October 1954 and liberated immediately or after propagation in the laboratory by a method that is described. More than 3,000 adults were released in 24 colonies over a period of three months, and a survey made four months after the initial liberation showed that 17 colonies had become established and were affording an average of 72 per cent. parasitism of the pupae of *E. philippinensis*.

Laboratory observations showed that females of *Pediobius* oviposited in fifth-instar larvae and that 6–34 adult parasites emerged from each parasitised pupa. Eggs were sometimes laid in younger larvae, in which case the progeny did not usually survive, but not in pupae or in the larvae or pupae of predacious Coccinellids. Development from egg to adult lasted 13–16 days, and adults of both sexes fed on the body fluids of the host larvae.

Wollerman (E. H.) & Putnam (L. S.). **Daphnids help to screen Systemics.** —*J. econ. Ent.* **48** (1955) no. 6 pp. 759–760, 1 fig., 2 refs. Menasha, Wis., 1956.

The translocation in plants and toxicity to insects of systemic insecticides are usually tested by comparing the mortality rates of insects feeding on treated and untreated plants. A more rapid method was evolved, using *Daphnia pulex* (L.) as an indicator [*cf. R.A.E.*, A **43** 35]. Samples of 20 gm. freshly cut leaves from treated and untreated plants are ground with 400 ml. strained river water for five minutes and filtered, and examples of *D. pulex* transferred to the filtrate in dishes are examined for mortality after 1–24 hours. River water is used because tap water usually contains chlorine and has a variable pH and mineral content. Following a preliminary test with leaves from cut branches of black locust [*Robinia pseudacacia*] set in a 50 per cent. dilution of Systox (32 per cent. demeton [diethyl 2-(ethylmercapto)ethyl thiophosphate]), an experiment was carried out on the soil treatment of *Robinia* trees 5–6 ft. high. The results showed that treatment with 200, 400 or 800 ml. Systox per tree resulted in 94–100 per cent. mortality of *D. pulex* in two hours on the day after treatment and in 100 per cent. in one hour ten days later. Applications of 2–10 ml. per tree resulted in no significant mortality in 1·5 hours after 49 days, when a dose of 50 ml. caused 88 per cent. kill.

Wollerman (E. H.), Reese (C. R.) & Kiefer (A. S.). **Control of Black Locust Insects by Systemics.**—*J. econ. Ent.* **48** (1955) no. 6 pp. 760–761, 4 refs. Menasha, Wis., 1956.

Black locust [*Robinia pseudacacia*] has been planted extensively on strip-mined areas in the central United States as a nurse crop in afforestation programmes, but is severely damaged by insects, mainly the borer, *Megacyllene robiniae* (Forst.), and experiments were therefore carried out in Ohio to determine whether systemic insecticides could usefully be employed for their control. Soil treatments were applied to vigorously growing trees 16 months old, and translocation and toxicity were gauged by caging the Membracid, *Enchenopa binotata* (Say) on the trees and testing leaf extracts by means of *Daphnia pulex* (L.) [*cf.* preceding abstract]. In the first test, the trees were treated with 2, 10 or 50 gm. BHC (10 per cent. γ isomer), γ BHC as lindane, or alpha-beta cake (a by-product of the preparation of lindane from BHC) or 2, 10 or 50 ml. demeton [diethyl 2-(ethylmercapto)-ethyl thiophosphate] or schradan, diluted with sand or water and applied round the trees at a depth of 3–4 inches, and toxicity was estimated 42 days later. Since the lower dosages did not show any definite trends, the results for all three were combined. All materials caused some mortality of both test animals. Demeton showed the greatest toxicity to *D. pulex*, giving complete kill in seven hours, but it was less toxic than 10 per cent. γ BHC to *E. binotata* (42 and 60 per cent. mortality, respectively, of insects caged on the trees for 20 days). These conflicting results may have been due to

the low doses used and uneven uptake by the roots. Treatment with demeton at higher rates (200 and 400 ml. per tree) and assessment one day later resulted in 60 and 85 per cent. mortality of *E. binotata* caged on the trees for one day and in 94 and 100 per cent. mortality of *D. pulex* left in leaf extracts for one hour, and when the rate was 200, 450 or 908 ml. per tree, mortality of *E. binotata* caged on the trees for 14 days eight days after application, and of *D. pulex* after immersion for one hour 11 days after application, was complete or almost so. It is concluded that translocation in *R. pseudacacia* is rapid, that foliage toxicity persists for long periods, and that the two test animals show similar responses, which are related to dosage, though differences in mortality due to variations in dosage disappear with time.

Smith (F. F.), Gooden (E. L.) & Taylor (E. A.). **Effect of Diluents on the acaricidal Action of Malathion and Aramite in Dusts.**—*J. econ. Ent.* **48** (1955) no. 6 pp. 762–763. Menasha, Wis., 1956.

Malathion and Aramite [2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite] gave good control of *Tetranychus telarius* (L.) on rose at Beltsville, Maryland, in 1951–52, when the dusts were diluted with pyrophyllite, but poor control in 1953, when attapulgite was used, and laboratory tests of various diluents for use with these acaricides were therefore made in 1954–55. Dusts were prepared from 15 per cent. wettable Aramite with diluent (1:9) or 25 per cent. wettable malathion with diluent (16:84) and applied at 70–75°F. to mites of the Beltsville (non-resistant) strain (*cinnabarinus* (Boisd.)) [which is the carmine strain known to be susceptible to acaricides (*cf. R.A.E.*, A **44** 57)] on young bean plants in a dust tower at a rate equivalent to about 50 lb. per acre. Aramite gave 91–99 per cent. mortality in 24 hours when mixed with calcium carbonate (ground calcite), pyrophyllite or talc but not more than 68 per cent. with attapulgite, kaolin, diatomite or montmorillonite, though mortality with the last two and fine attapulgite had risen to 78–82 per cent. after a week. With malathion, kaolin equalled calcium carbonate, pyrophyllite and talc in effectiveness (over 92 per cent. mortality in 24 hours), and diatomite and fine attapulgite were almost as good (87 per cent. mortality) whereas attapulgite of normal particle size and montmorillonite of the same size gave poor results.

York (G. T.), Schaffner (J. C.) & Brindley (T. A.). **Parasites of the European Corn Borer found infesting the Stalk Borer.**—*J. econ. Ent.* **48** (1955) no. 6 pp. 765–766, 3 refs. Menasha, Wis., 1956.

In 1952, *Lydella stabulans griseseens* R.-D. and *Sympiesis* (*Eulophus*) *viridula* (Thoms.), which had been introduced into the United States against *Pyrausta nubilalis* (Hb.) on maize [*cf. R.A.E.*, A **31** 288], were reared from larvae of *Papaipema nebris* (Gn.) in Iowa, this being the first record of field parasitism of other genera by introduced parasites of *Pyrausta nubilalis* in that country. In 1954, *Lydella* was obtained from 23 of 24 collections of *Papaipema* made in late June and July, and the first parasite adult emerged on 2nd July, when only half the *Pyrausta* larvae had reached the second or third instar. As *Lydella* does not develop well in larvae of such early instars, it is apparent that a generation was produced in *Papaipema* before parasitism of most of the first generation of *Pyrausta* occurred; there was no possibility that *Lydella* overwintered in *Papaipema*, since the latter passes the winter in the egg stage. The development of *Sympiesis* on *Papaipema* was similar to that of *Lydella*, the adults emerging at the same time. Field

observations and laboratory studies indicated rather poor synchronisation between *Lydella* and *Pyrausta*, since the *Lydella* adults emerge 7–10 days before those of *Pyrausta* and would die or be overmature before *Pyrausta* larvae were available as suitable host material. Since the generation produced in *Papaipema* gives rise to adults when the first generation of *Pyrausta* is at a suitable stage for parasitism, *Papaipema* serves as a good supplementary host and accounts for some of the differences in parasite populations in different parts of the country.

Glick (P. A.). **Pink Bollworm Moth Collections in Airplane Traps.**—*J. econ. Ent.* **48** (1955) no. 6 p. 767, 1 fig., 1 ref. Menasha, Wis., 1956.

Since there was evidence that a recent rapid spread of *Platyedra* (*Pectinophora*) *gossypiella* (Saund.) on cotton in the United States was due to migration of the moths, an aeroplane equipped with special traps was used in the Lower Rio Grande Valley of Texas from 18th August to 3rd September 1954 to investigate the occurrence of the insect in the upper air. Flights were made at different times between 5 a.m. and 10 p.m. and 239 ten-minute trap exposures were made at heights of 100–5,000 ft. at a speed of 50 miles per hour. Twelve moths were collected in all, at altitudes up to 1,000 ft. and under various atmospheric conditions; one taken 10–15 miles from the nearest cotton field, when the air was rough and convection very strong, had probably been carried by southerly winds from the cotton area. The moths have been shown by light-trap collections to be most active when the wind velocity does not exceed 6 miles per hour, but they were taken at 100 ft. at wind velocities up to 20 m.p.h. Two light-traps fitted with 15-watt ultraviolet fluorescent lamps were operated at a height of 100 ft. at Brownsville during the period of the test and caught 43 adults.

Taylor (E. A.) & Smith (F. F.). **Three Methods for extracting Thrips and other Insects from Rose Flowers.**—*J. econ. Ent.* **48** (1955) no. 6 pp. 767–768, 3 refs. Menasha, Wis., 1956.

Three methods of extracting *Frankliniella tritici* (Fitch) and other insects from rose flowers were compared at Beltsville, Maryland, in 1954. These comprised stirring the flowers in a detergent solution for ten minutes, allowing the extracted insects to settle and then skimming off plant material, decanting about half the liquid and placing the jar over cross-section paper for counting; suspending the flowers overnight on a rack over water in a covered jar with cottonwool moistened with turpentine, fastened near the top, and counting as before; and allowing roses to dry in an opaque carton placed on its side, with a test-tube protruding horizontally towards a source of light from the top of one end, so that the slow drying of the flowers and the tendency of the insects to climb and to be attracted to light caused them to collect in the tube, from which they were removed daily. The results indicated no difference between methods in the numbers of adults of *F. tritici* recovered, but significantly more adults of *Orius insidiosus* (Say) were collected by the last method, owing to the transformation of nymphs during the ten-day extraction period; this, therefore, appears to give the most accurate estimation of potential populations of thrips and *Orius*. The detergent method proved to be the most useful for rapid extraction of thrips; it removed all of them, whereas the turpentine method left about 20 per cent. dead in the flowers and similar numbers died in the cartons used in the third method.

Michelbacher (A. E.) & Oatman (E.). **Marked suppressing Action of Schradan on the Walnut Aphid.**—*J. econ. Ent.* **48** (1955) no. 6 pp. 768–769. Menasha, Wis., 1956.

A spray of schradan proved outstanding against *Chromaphis juglandicola* (Kalt.) on walnut in California in 1953 [*cf. R.A.E.*, A **44** 373]. In a further test in 1954, applications of 1·5, 2 or 2·5 lb. technical schradan in 200 U.S. gals. water per acre combined with the spray applied against the codling moth [*Cydia pomonella* (L.)] in early May in the north of the San Joaquin valley kept the Aphid at an extremely low level until long after harvest, so that practically no sexual forms were produced and few winter eggs laid. As a result, the numbers of Aphids per leaflet on the leaflets next to the terminals in April and early May 1955, when infestation was very heavy, averaged only 0·5–1·5, 0·16–0·4 and 0·02–0·15 for the three doses, as compared with 10·2–37·5 for 0·25–1 lb. Systox [diethyl 2-(ethylmercapto)ethyl thiophosphate (demeton)] per acre and 23·6–42·8 for non-systemic aphicides applied at the same time. After 4th May, populations increased rather rapidly owing to the migration of alates from neighbouring plots. Similar results were obtained at San Jose [*cf. loc. cit.*], though there was less visible foliage improvement there because the general infestation in 1955 was less severe. The schradan treatments also had a controlling effect on crawlers of *Eulecanium* (*Lecanium*) *pruinosum* (Coq.) and were effective against *Tetranychus pacificus* McG., but not *Metatetranychus ulmi* (Koch).

Tippins (H. H.) & Hyche (L. L.). **Control of Flower Thrips on Blackberries.**—*J. econ. Ent.* **48** (1955) no. 6 pp. 769–770, 2 refs. Menasha, Wis., 1956.

Frankliniella tritici (Fitch) occurs in large numbers on cultivated blackberry (Youngberry) in Alabama and as it is said to be a cause of incomplete fertilisation and inferior fruits, experiments on its control were begun in 1954. Sprays were applied about five days before and two days after the first picking of ripe berries, and infestation counts on the fruit were made at intervals of 2–4 days during the three weeks of the picking season. Treatment with 1 pint 25 per cent. parathion or 1·5 pints 50 per cent. malathion per 100 gals., both in emulsion concentrates, on the first date only, gave highly significant control of the thrips throughout the season, and this was not significantly improved by a second application. Treatment with 0·25 pint 43 per cent. miscible TEPP [tetraethyl pyrophosphate] per 100 gals. on one or both dates caused inadequate reductions in population, and 1·5 pints nicotine sulphate was ineffective. Residue determinations made four days after the second application of parathion or malathion showed not more than 0·5 part per million of either on the berries.

Smith (R. H.). **The Effect of Wood Moisture Content on the Emergence of Southern *Lyctus* Beetle.**—*J. econ. Ent.* **48** (1955) no. 6 pp. 770–771, 1 graph. Menasha, Wis., 1956.

The rearing of large numbers of adults of *Lyctus planicollis* Lec. at Beltsville, Maryland, was found to be a slow and difficult operation, and investigations to improve the method showed that increasing the moisture content of heavily infested oak or hickory wood from 8 to 12 per cent. increased adult emergence by 34 per cent., though it did not accelerate it. The cultures were subsequently transferred to a greenhouse where the

moisture content of the wood could be maintained at 15–18 per cent., and this approximately doubled the supply of beetles.

Turner (W. F.) & Pollard (H. N.). **Additional Leafhopper Vectors of Phony Peach.**—*J. econ. Ent.* **48** (1955) no. 6 pp. 771–772, 3 refs. Menasha, Wis., 1956.

In tests in the United States to determine further vectors of the virus disease of peach known as phony peach [*cf. R.A.E.*, A **40** 182], transmission by *Draeculacephala* sp. and *Homalodisca insolita* (Wlk.) was obtained in the laboratory. The species of *Draeculacephala* used were *D. portola* Ball and *D. balli* Van D., and the batch that effected transmission consisted of five individuals. After feeding on a source of the virus, they were transferred to six successive healthy trees and infected the fourth of these. As only females were available for examination at the end of the test, specific identification was not possible. Six other batches failed to transmit, and it appears that these insects are so accustomed to feeding on grasses that they have lost most of their ability to feed from the xylem of woody plants, even though they may subsist for considerable periods when caged on them.

H. insolita appeared to be an effective vector, 14 of 33 batches, each of 2–19 insects, transmitting the virus. Males and females acquired it from infected peach and plum and transmitted it to peach, with a latent period of not more than 10–11 days in two instances. In four tests, two trees were infected in succession, longer series not being attempted, and in one, transmission was effected by the feeding of only two insects. *H. insolita* is not indigenous in the area in which the disease occurs, having been collected only in Mexico, Arizona, New Mexico and western Texas before 1950 and not in Georgia until that year; it is now generally established throughout the coastal plain of the Gulf Coast States. Eggs have been found in the south-east only on Johnson grass (*Sorghum halepense*) and Texas millet (*Panicum texanum*), but a few adults have been seen feeding on peach twigs, and although it seems unlikely to become an important natural vector of the virus, it probably occasionally disseminates it.

These results support the view that any Cicadellid of the subfamily Tettigellinae can act as a vector, efficiency depending on feeding habits and not necessarily on natural habitat or usual choice of food-plants. None of the six species known to transmit the disease [*cf. loc. cit.*] feeds primarily on twigs or branches of woody plants throughout the year, and this emphasises the importance of preventing the introduction of the disease into new areas in which Cicadellids have any degree of natural association with peach trees.

Hopkins (A. R.) & Walker (R. L.). **Mortality Studies on hibernating Boll Weevils.**—*J. econ. Ent.* **48** (1955) no. 6 p. 772, 4 refs. Menasha, Wis., 1956.

Mortality of hibernating adults of *Anthonomus grandis* Boh. in the cotton belt of the United States is known to be high [*cf. R.A.E.*, A **31** 187], and experiments were carried out in South Carolina in the winter of 1954–55, when both temperature and rainfall were below normal, to determine at what period the greatest mortality occurred. In the first, field-collected adults were caged at the edge of a wood over a natural layer of leaf mould and fallen leaves about 3–4 inches deep on 19th–20th October, and samples of the trash and half an inch of top soil were examined at various times

during the winter. Mortality was 53·5 per cent. by 1st December, possibly because many of the weevils were not ready for hibernation when put in the cages, and had increased to 61·2 per cent. by 4th January and 73·3 per cent. by 31st January; the second of these increases was statistically significant. It reached 78·4 per cent. by 16th March and 81·9 per cent. by 18th April, the increase after 31st January being significant. In the second experiment, the weevils were caged over the trash on 1st November. Mortality rose significantly from 23·3 per cent. on 17th November to 56·6 per cent. on 30th November and 63·3 per cent. on 14th January, but a further increase to 73·3 per cent. on 18th April was not significant. Both tests showed over 50 per cent. mortality by 1st December and a significant increase between 4th and 31st January.

De (R. K.) & Gopa Konar. **Effect of** *Bacillus thuringiensis* **on** *Trogoderma granarium*.—*J. econ. Ent.* **48** (1955) no. 6 pp. 773–774, 2 refs. Menasha, Wis., 1956.

An account is given of the first of a series of tests with *Bacillus thuringiensis* against insects that attack stored grain in India. Adults of *Trogoderma granarium* Everts, a serious pest of wheat, were collected from a wheat store at Alipur for rearing, and the larvae were transferred to petri dishes containing sound wheat that had been treated 24 hours earlier with a powder prepared from a pure culture of the bacterium, at the rate of 1 : 500 by weight, or had been left untreated. Observations were made at intervals of 15 days from 31st August to 1st January, during which period the average temperature ranged from about 82 to 65°F. and the average relative humidity was 21·7 per cent. There was 0·17 per cent. mortality in both treated and untreated wheat in the first fortnight and none in untreated and 0–0·67 per cent. in treated wheat thereafter. The insignificant effect may have been due to the habit of the larvae of feeding within the grain and leaving most of its surface intact, the spores ingested by the larvae while boring into the kernel being insufficient to cause death.

De (R. K.). **Effect of Streptomycin on some stored Grain Insects.**—*J. econ. Ent.* **48** (1955) no. 6 pp. 774–775, 2 graphs, 4 refs. Menasha, Wis., 1956.

In tests to determine whether very low dosages of streptomycin were toxic to insects that attack stored grain in India, adults of *Calandra* (*Sitophilus*) *oryzae* (L.) and *Tribolium confusum* Duv. were released in petri dishes containing rice or wheat that had been mixed with the antibiotic, which was used at 1 : 1,000 or 1 : 5,000 by weight with the rice and 1 : 5,000 with the wheat. None of the treatments increased the rate of mortality, as compared with that in untreated grain, and it is concluded that the doses used were too low to be effective.

Toxic Hazards of Pesticides to Man. Report of a Study Group.—*Tech. Rep. World Hlth Org.* no. 114, 51 pp., refs. Geneva, 1956.

This is the report of a study group that met under the auspices of the World Health Organisation in June 1956. The main subjects considered in it are the toxic properties of pesticides (notably insecticides, fungicides and herbicides), the incidence and nature of human poisoning, measures for the protection of operators handling pesticides, the contamination of food and water, effects on domestic animals and fish, and the control of pesticide

hazards by means of regulations. Three annexes contain information on laboratories carrying out investigations on the vertebrate toxicology of pesticides, the degree of exposure of workers to insecticides and the relation of this exposure to the toxic dosage, and respirators and dust masks suitable for pesticide operators.

Szent-Ivany (J. J. H.). **Two new Stem Borers of Cacao in New Guinea.**—*FAO Plant Prot. Bull.* **4** no. 12 pp. 177–178, 4 refs. Rome, 1956.

Three species of *Pantorhytes* are recorded boring in the stems of cacao in the Territory of Papua and New Guinea. One of them is *P. plutus* (Oberth.), which has long been known as a pest of the crop in New Britain [*cf. R.A.E.*, A **27** 277] and was observed by the author attacking it in Lihir Island, to the east of New Ireland. The other two were found in 1955, *P. proximus* Faust * near Lae, in north-eastern New Guinea, and *Pantorhytes* sp. in the north of Papua. The females of *P. proximus* oviposited on the stems or branches of the trees, and the larvae bored into the bark and cambium layer, most of them being found in and near the jorquette; up to 20 larvae and pupae were observed in a single tree. Cacao less than 2½–3 years old was rarely attacked, and infestation by 2–3 larvae in a young tree did not normally result in damage of any importance. Repeated damage by many larvae in the centre of the jorquette often resulted in cracking of the stem and eventual death of the tree, and large-scale boring in the branches caused these to wither and break off. The adults were not observed to feed on the leaves of cacao, but they are thought likely to do so. The larvae of *Pantorhytes* sp. were less commonly associated with the jorquette than were those of *P. proximus*, and they were further observed feeding in the pods, on which the adults fed externally.

Most species of *Pantorhytes* are found in lowland rain forests, and the larvae are probably polyphagous. Since most of the cacao plantations in Papua and New Guinea were established in virgin rain forest and many are still surrounded by it, further invasions can be expected, though large populations appear only in neglected plantations in which secondary bush has been allowed to develop. Possible methods of control are suggested.

Outbreaks and new Records.—*FAO Plant Prot. Bull.* **4** no. 12 pp. 188–189; **5** no. 1 pp. 14–15. Rome, 1956.

It is officially reported (p. 188) that *Ceratitis capitata* (Wied.), which had not previously been recorded from Holland, was found in 1955 infesting peaches ripening in early September in gardens in Limburg. Cages were placed over the soil beneath the infested trees in late May 1956 to trap any adults that emerged, but none had been obtained by mid-July. Of seven puparia collected from the soil in May and examined in the laboratory, one contained a living individual, in spite of the severity of the winter (minimum temperature −26°C. [−14·2°F.]), one was dry and shrivelled, and five contained dead flies in an advanced stage of development. *C. capitata* can therefore overwinter in the area.

It is stated from the U.S. Department of Agriculture (p. 189) that the spotted alfalfa Aphid [*Myzocallis maculata* (Buckt.)], for which the name *Pterocallidium* sp. is used, continued to spread on lucerne in 1955, when infestation was severe in Arizona, California and Nevada and also occurred in Arkansas, Colorado, Idaho, Kansas, Louisiana, Missouri, Nebraska, Oklahoma, Texas and Utah [*cf. R.A.E.*, A **45** 11, etc.]. Damage was

* Wrongly stated to have been identified as *P. proximus* Sternb.—*Ed.*

particularly severe in Oklahoma in early 1956. The Aphid was first found east of the Mississippi late in April of that year, when it appeared in northern Florida, and it was subsequently observed in Georgia, Illinois and Mississippi. The same Department also reports (p. 15) that an adult female of *Dacus cucurbitae* Coq. was taken at Los Angeles late in July 1956. An intensive scouting and trapping programme was instituted. This appears to be the first record of the fruit-fly anywhere in America; its distribution and host-fruits, chief amongst which are cucurbits, are briefly reviewed.

Banerjee (S. N.) & Basu (A. N.). **Evaluation of Insecticides against the Brinjal Shoot and Fruit Borer in India.**—*FAO Plant Prot. Bull.* **5** no. 1 pp. 7–8, 1 fig., 2 refs. Rome, 1956.

Leucinodes orbonalis Gn. is the most injurious pest of egg-plant (*Solanum melongena*) in West Bengal. Attack begins 3–4 weeks after transplanting, and the larvae bore into the young axillary shoots, which droop and ultimately wilt, and into the petioles and mid-ribs of large leaves. Such attack rarely kills the plants, though it hinders their growth, but attack on the stem, which is less common, results in death. The larvae also bore in the fruits, rendering them unfit for human consumption. All stages are present throughout the year. Field experiments on treatments to protect the plants during the pre-fruiting stage were carried out with various insecticides. An emulsion spray containing 0·08 per cent. endrin proved the most effective and economical, the other products being either ineffective or effective only at rates of application that were economically impracticable. The endrin spray should be applied three weeks after transplanting and again after a further three weeks.

Hami (M. A.). **Effect of Borer Attack on the Vitamin C Content of Brinjals.** —*Pakist. J. Hlth* **4** no. 4 pp. 223–224, 9 refs. Lahore, 1955.

The content of vitamin C (ascorbic acid) in the fruits of two varieties of brinjal (*Solanum melongena*) grown in Pakistan was found to be reduced by 68 per cent. as a result of attack by *Leucinodes orbonalis* Gn.

Varma (P. M.). **Studies on the Relationship of the Bhendi Yellow Vein-mosaic Virus and its Vector, the White-fly** (*Bemisia tabaci* **Gen.**).—*Indian J. agric. Sci.* **22** pt. 1 pp. 75–91, 1 pl., 12 refs. Delhi, 1952. **Persistence of Yellow-vein Mosaic Virus of** *Abelmoschus esculentus* **(L.) Moench in its Vector** *Bemisia tabaci* **(Gen.).**—*Op. cit.* **25** (1955) pt. 4 pp. 293–302, 7 refs. 1956.

It is stated in the first paper that considerable losses of *Hibiscus esculentus*, which is an important vegetable crop in Bombay State, result from a disease known as yellow vein mosaic. Previous work showed that this is caused by a virus that is transmitted by grafting and by *Bemisia tabaci* (Gennadius), and an account is given of studies on the effectiveness of this Aleyrodid as a vector. When newly emerged adults that had fed for 12–24 hours on diseased plants were transferred singly or in groups of 3–50 to healthy ones, single adults infected 5 of 17 of the latter, groups of ten infected 16 of 17, and groups of 15 or more infected all of them. None of the insects transmitted after feeding for only 15 or 30 minutes on diseased plants, but 48·5, 88·5 and 100 per cent. did so after feeding for 1, 2 and 3–18 hours, respectively. When the insects were kept without food for 1, 2, 4 or 6 hours before feeding on diseased plants (for 15–240 minutes), the

percentages that became infective averaged 13·3, 16, 33·3 and 38·6, respectively, as compared with 5·3 for those that had not fasted. In this test, some of the insects became infective after feeding for only 30 minutes on the virus source, the proportion that did so increasing with the fasting period.

In a test with groups of 20 adults that had fed for 24 hours on diseased plants, the percentage infection of healthy plants reached 100 only when the insects fed on them for at least three hours; for feeding periods of 5, 30, 60 and 120 minutes, the percentages infected were 0, 16·6, 67·8 and 96·4, respectively. When the insects fed on diseased plants for 20 hours, fasted for 2, 3 or 4 hours and were then placed in groups of 20 on healthy plants, the numbers of the latter that became infected were 1, 5 and 6, respectively, out of ten for a feeding period of 10 minutes, 3, 7 and 7 for one of 20 minutes, and 8, 10 and 9 for one of 30 minutes. A similar test with single insects and post-infection fasting periods of up to eight hours confirmed that a feeding period of ten minutes on the healthy plant was sufficient for transmission of the virus, but showed that there was no appreciable improvement in the percentage infection when the fasting period was increased beyond four hours.

In tests on the interval between the uptake of virus from the diseased plant and its transmission to a healthy one, a minimum period of seven hours was found necessary, though few of the insects were able to transmit it so soon. Insects that had fed on diseased plants for 20–24 hours mostly remained infective until they died, some three weeks later. Transmission was erratic in some cases, but there was little indication of any loss of infectivity with age. The virus is therefore of the persistent type. The insects were able to acquire it from the youngest leaf of an artificially infected plant several days before visible symptoms developed, and from the oldest one last of all. Of a total of 500 adults that fed on a virus source for 48 hours, 141 males and 194 females subsequently transmitted, showing that the females are the more efficient vectors.

It is shown in the second paper that when females of *B. tabaci* that had fasted for four hours fed for 0·5, 1, 2, 4, 6 or 24 hours on diseased plants, 35·8, 62·5, 73·6, 71·8, 70 and 76·1 per cent., respectively, subsequently transmitted the virus. To determine the number of days for which infectivity was retained, the insects were transferred singly every 24 hours, until they died, to successive healthy seedlings. The latest days on which transmission occurred were the 3rd, 5th, 10th, 17th, 22nd and 25th for the six feeding periods, respectively. Transmission was somewhat erratic, but the number of days on which individual flies transmitted increased with the period of feeding on the virus source, though there was little difference in this respect between feeding periods of six and 24 hours.

Fernando (H. E.), Weerawardena (G. V.) & Manickavasagar (P.). **Paddy Pest Control in Ceylon.**—*Trop. Agriculturist* **110** no. 3 pp. 159–174, 5 figs., 8 refs. Peradeniya, 1954.

Severe damage to rice in Ceylon is caused by *Thrips oryzae* Williams, *Scotinophara lurida* (Burm.), *Spodoptera mauritia* (Boisd.), *Nephotettix bipunctatus* (F.), *Tettigella* (*Tettigoniella*) *spectra* (Dist.) and *Zygina* (*Erythroneura*) *subrufa* (Motsch.), which attack the plants in the seedling stage, by *Leptocorisa varicornis* (F.), which sucks the grains in the stage of milky ripeness, and by the stem borer, *Schoenobius bipunctifer* (Wlk.), which attacks plants of all ages. In the first part of this paper, notes are given on the appearance of these pests, on the damage they cause and on their bionomics and control by means of modern organic chemicals. It is pointed out that insecticides are in many cases applied too late to be fully

effective, but that timely applications would result in large increases in yield that would more than justify the cost of treatment. In the second part, various types of equipment suitable for the application of dusts and sprays to rice are described and their advantages discussed. The rice-fields are usually too scattered or too remote from air-strips for treatment from aircraft, but in a recent test in which large tracts in two districts were sprayed from an aeroplane, flying 8–15 ft. above the plants, an 18 per cent. DDT emulsion concentrate used at 2 pints per 1·5 gals. spray was applied at a rate of 2–3 gals. per acre and gave complete control of *Spodoptera mauritia*.

Iwata (K.) & Nagatomi (A.). **Biology of a Tachinid, *Phorocerosoma forte* Townsend, parasitic on *Oxya japonica* Willemse in Japan.**—*Mushi* **26** pt. 7 pp. 23–34, 1 pl., 1 fig. Fukuoka, 1954.

The following is based on the authors' summary. Observations in southern Honshu in 1950–52 showed that a Tachinid, *Phorocerosoma forte* Tns., parasitises adults and last-instar nymphs of the Acridid, *Oxya japonica* Willemse, an important pest of rice in Japan. Nymphs in the earlier instars were not examined. Only one egg was usually laid per host, the majority being found on the legs. On hatching, the larva entered the body of the host, pierced a respiratory hole in the tympanum, and fed internally for 17–36 days, emerging finally between the abdominal segments to pupate in the soil. Hosts survived for 1–49 days in the laboratory after the emergence of the parasite larvae, though their reproductive capacity was in many cases reduced. Averages of 10 and 7·9 per cent. of *O. japonica* were found in 1951 and 1952, respectively, to have had the tympanum pierced by *P. forte*. There are thought to be at least two generations of the parasite a year.

Hoy (J. M.). **Manuka Blight: Scale Insects associated with Manuka Species in New Zealand.**—*N. Z. J. Agric.* **89** no. 6 pp. 601, 603–604, 4 figs., 2 maps, 7 refs. Wellington, N.Z., 1954.

In addition to the introduced species of *Eriococcus* [*orariensis* Hoy] that has become widespread on manuka (*Leptospermum scoparium*) in New Zealand, the distribution and bionomics of which are reviewed [*cf. R.A.E.*, A **44** 421], another introduced species of the same genus, *E. leptospermi* Mask., is also present on the tree in a restricted area to the north of Christchurch, South Island. It is capable of causing much damage, but observations on it are difficult because the area has been overrun by *E. orariensis*. The two species can be distinguished by the fact that the sac of the female of *E. leptospermi* is always exposed, whereas that of *E. orariensis* is hidden beneath the exfoliated bark. Six other Coccids also occur on manuka [*cf.* **40** 29], and their distribution is shown on a map; of these, only *Coelostomidia wairoensis* (Mask.) is widely distributed on both islands, and it is commoner on kanuka (*L. ericoides*) than on manuka.

Hammond (G. H.). **Long-term Fluctuations in Populations of White Grubs (*Phyllophaga* spp.) in Sod in eastern Ontario.**—*Emp. J. exp. Agric.* **22** no. 85 pp. 59–64, 1 map, 4 refs. Oxford, 1954.

An account is given of observations on the reduction in numbers of *Lachnosterna* (*Phyllophaga*) *anxia* (Lec.) and *L.* (*P.*) *fusca* (Froel.), considered together, in the course of a generation and the fluctuations in numbers

between generations under different conditions of soil and vegetation in eastern Ontario. Counts were made in an old hay meadow each year from 1938 to 1949, during which period four complete generations developed. The meadow was situated on a hillside and divided into high, low and intermediate ranges with 80 contiguous plots, each 20 × 25 ft. in area, in each range; the sampling unit was ¼ sq. yd. per plot per year. The generations remained distinct throughout the period, and there was no deviation from the three-year life-cycle [*cf. R.A.E.*, A **38** 129]. In each generation, first-year larvae were more numerous in the high and intermediate ranges, which were on sandy loam with a content of organic matter ranging from 5 per cent. at the highest points to 15 per cent. at the lowest and provided favourable conditions for the ovipositing females, than in the low range, which was on dark grey loam containing 20–25 per cent. organic matter over clay into which the larvae could penetrate for only one or two inches. Second-year larvae were on the average 63 per cent. as numerous as first-year ones, regardless of altitude or generation. At the higher altitudes, the larvae were killed largely by insect parasites, predators and lack of food, and at the lower altitudes, where the larvae were less numerous, they were reduced principally by excessive moisture. Percentage survival of second-year larvae averaged 50, 61 and 75 per cent. on the high, intermediate and low ranges, respectively, but was about 100 in 1948–49, when populations were very low. These larvae are reduced chiefly by lack of food, cannibalism and predacious mammals and birds. In the third year, the larvae, pupae and newly emerged adults are deeper in the soil and protected from adverse climatic conditions and vertebrates, though the latter attack adults leaving and entering the soil. At the end of each generation, numbers were fairly uniform at all altitudes. They bore no consistent relation to the initial population of the next generation, however, which depended on mortality of the adults due to predators and rainfall during the periods of oviposition, hatching and early larval development; egg mortality was usually light unless the soil was very dry.

Willis (E. R.) & Roth (L. M.). **Reactions of Flour Beetles of the Genus *Tribolium* to Carbon Dioxide and dry Air.**—*J. exp. Zool.* **127** no. 1 pp. 117–152, 6 figs., 52 refs. Philadelphia, Pa., 1954.

The following is largely the authors' summary. The reactions of *Tribolium castaneum* (Hbst.) and *T. confusum* Duv. to carbon dioxide at concentrations of 0·25–90 per cent. in air were studied in an olfactometer. Males and females of *T. castaneum* were increasingly attracted as the concentration rose from 0·25 to 15 per cent. and decreasingly so as it rose from 30 to 40 per cent.; at a concentration of about 50 per cent., equal numbers were attracted and repelled, and between 60 and 90 per cent., the number repelled increased with the concentration. Males of *T. confusum* were slightly attracted by all concentrations; females of this species were attracted by concentrations of 30–90 per cent., but most strongly by one of 70 per cent. In experiments with a covered arena about 6 ins. in diameter, through the centre of which gases could be introduced, *T. castaneum*, but not *T. confusum*, was attracted in highly significant numbers by carbon dioxide at 15 per cent. and also, when in a state of normal water balance, by dry air.

The sensilla basiconica on the club segments of both sexes of *T. castaneum* were tentatively identified as the olfactory receptors. Diminution in the attraction of these beetles towards carbon dioxide, both in the olfactometer and in the arena, was correlated with reduction (by amputation) in the number of club segments and associated basiconic sensilla. The aggregation of beetles in the odour-bearing stream in the olfactometer was a result of

undirected movement; in the arena, the orientation of *T. castaneum* towards odour was a directed response. The antennal hygroreceptors that mediate the dry reaction in non-desiccated *T. castaneum* are directional, but the hygroreceptors on the maxillary palpi are non-directional. The hypothesis is advanced that the response to carbon dioxide may enable *Tribolium* to become orientated towards foods that produce this gas either by endogenous respiration or by the respiration of invading micro-organisms or insects.

Bletchly (J. D.). **A little-known Borer in imported Softwood; *Serropalpus barbatus* Schall. (Coleoptera, Melandryidae). Review of Literature and recent Occurrences in Great Britain.**—*Forestry* **28** no. 1 pp. 67–72, 19 refs. London, 1955.

Instances are recorded of damage by *Serropalpus barbatus* (Schaller) observed in 1949–53 in timber of *Abies* spp. imported into Britain, mainly from Yugoslavia. The injury is indistinguishable from that caused by Siricids and may have been confused with it in the past. All stages of the Melandryid are described and its distribution and bionomics are reviewed from the literature; there is no evidence that it is established or an important pest in Britain.

Jørgensen (J.). **Løgfluen, *Hylemyia antiqua*, Meig. Resultater af nogle biologiske undersøgelser og bekaempelsesforsøg.** [The Onion Fly, *H. antiqua*. Investigations on Bionomics and Experiments on Control.]—*Tidsskr. Planteavl* **59** pt. 2 pp. 252–279, 5 figs., 41 refs.; also as *Beretn. Forsøgsv. PlKult.* no. 509. Copenhagen, 1955. (With a Summary in English.)

Løgfluen. [The Onion Fly.]—*Medd. Forsøgsv. PlKult.* no. 526, 4 pp. Copenhagen, 1955.

Hylemyia antiqua (Mg.) is by far the most important insect pest of onions in Denmark, and in these papers, the second of which is a greatly condensed version of the first, an account is given of observations on its bionomics and control carried out in recent years. These showed that although most of the hibernating pupae occur in the soil, some are found in diseased onion bulbs and in débris removed from the fields before the larvae have pupated. Emergence of the adults begins as early as late April but does not reach its peak until mid-May; it continued from 17th April to 10th July in 1953, but was completed in much shorter periods in other years. Oviposition begins about 20th May, and attack on spring-sown onions becomes noticeable about 1st June. Larvae in all instars are present from mid-June to early July. Pupation begins in mid-June, and first-generation adults emerge at the end of that month, sometimes while those of the overwintering generation are still present, though many of the pupae overwinter. Second-generation larvae occur from the end of July to September or October, but cause little damage, and there may even be a small third generation. Shallots and leeks are attacked in addition to onion.

The natural enemies of the Anthomyiid in Denmark include a nematode, *Heterotylenchus aberrans*, of which the fertilised females enter the larvae and oviposit when the latter have become adult. The larval nematodes moult once and develop into female adults, which reproduce parthenogenetically, their eggs giving rise to male and female larvae. These leave the female host through the genital tract and complete their development under free-living conditions, the adults pairing. The alternation of parthenogenetic and gamogenetic generations and the simultaneous presence of females of the two in the body cavity of the host are noteworthy. The

nematode is sometimes present in large numbers and almost always causes sterilisation of the female host. The percentage parasitism is not high, being 7·5–16 in females and 5–21·5 in males in 1948–50. The other natural enemies of the Anthomyiid include Cynipid parasites and the Staphylinid, *Aleochara bilineata* Gylh., but they afford negligible control.

Tests of the value of various insecticides in seed dressings were made in 1947–49 and 1952–54. Calomel gave poor results, DDT and BHC were insufficiently effective and only chlordane afforded a high degree of protection [*cf. R.A.E.*, A **44** 443]. It was used at rates of 6·2–20 per cent. of the weight of seed, and reduced the percentage of plants injured throughout the season from 93·4 to 9·5 in 1952, 81·5 to 2 in 1953, and 96·8 to 2–2·4 in 1954, but reduced germination considerably at the maximum rate of application. Chlordane and γ BHC were also tested in 1953 as slurries for dipping onion setts, chlordane as a 1:1 mixture of a 10 per cent. powder and water, and γ BHC as a 2:5 mixture of a 2·5 per cent. powder and water. They reduced the percentage of plants attacked from 52 to 0 and 8, respectively. Chlordane also proved effective in 1954 as a soil treatment, a 10 per cent. preparation being applied at a rate equivalent to about 6 lb. per 100 yards of row before the plants were set out and reducing the percentage attack from 36·1 to 5 on onions and from 13·5 to 0·7 on shallots.

Hellqvist (H.). **Bekämpningsförsök mot kålflugans och morotflugans larver.** [Tests on the Control of Cabbage-fly and Carrot-fly Larvae.]—*Växtskyddsnotiser* 1955 no. 1 pp. 4–14, 4 figs. Stockholm, 1955.

The opening of an experiment station in northern Sweden enabled tests to be begun there in 1953–54 on chemical treatments for the control of *Hylemyia* spp., notably *H. floralis* (Fall.), on crucifers and *Psila rosae* (F.) on carrots. Lindane [γ BHC], chlordane and aldrin were used in proprietary powders and emulsion concentrates, and dieldrin in an emulsion concentrate, and the results were estimated from the yield and condition of the plants at harvest. All the insecticides reduced infestation by *Hylemyia* on cabbage or cauliflower when applied in various ways, but detailed comparisons between them could not be made. Dipping the roots at the time of transplanting appeared in general to be less effective than watering the growing plants twice with suitable dilutions of any of the concentrates, but was to be further investigated. Control on a root crop (turnip) was harder to obtain, and dust applications to the rows at the time of sowing were of little value unless further protection was afforded by spraying. On carrots, treating the seed with 5 per cent. of its weight of 20 per cent. γ BHC dust gave excellent control of *P. rosae*, and additional applications of BHC dust to the rows at sowing or of a BHC or chlordane spray to the growing plants afforded little improvement.

von Rosen (H.). **Två nyttiga småsteklar.** [Two useful Microhymenoptera.] —*Växtskyddsnotiser* 1955 no. 2 pp. 36–40, 6 figs. Stockholm, 1955.

Delphacodes (*Calligypona*) *pellucida* (F.) injures cereal crops in northern Sweden by sucking the sap of the plants and inserting its eggs, sometimes in large numbers, into the internodes. The eggs are destroyed by the larvae of the Pteromalids, *Amblymerus aequus* (Wlk.) and *Panstenon assimilis* (Nees) (*oxylus* (Wlk.)), which are polyphagous and sometimes attack larvae of their own or other species. *Panstenon* seems usually not to have more than one generation a year, whereas *Amblymerus* has two. Although they destroy large numbers of eggs of the Delphacid, they do not afford adequate control.

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